Fishery Data Series No. 98-5

Estimates of Commercial Harvest and Escapement of Coho Salmon Stocked Into Northern Cook Inlet Streams, 1996

by

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May 1998

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

Juvenile coho salmon *Oncorhynchus kisutch* reared in hatcheries and released into several Northern Cook Inlet (NCI) freshwater systems in 1995 returned to Upper Cook Inlet (UCI) in 1996. Some fish in each release group were marked with an adipose finclip and a coded wire tag. Marked coho salmon were recovered in 1996 from selected commercial fisheries and escapements. Fish were sampled from escapements to assess straying and long-term tag retention after release. Recoveries of marked fish from selected UCI commercial harvests were used to estimate harvest of hatchery-produced coho salmon.

In 1996 the UCI mixed-stock commercial fisheries harvested 321,411 coho salmon. The majority (90%) of coho salmon were harvested in the Central District drift gillnet fishery (171,361), the Northern District set gillnet fishery (78,097), and the Central District Upper Subdistrict (eastside) set gillnet fishery (40,548). Sample efforts focused on coho salmon harvested in these three fisheries. NCI hatchery stocked coho salmon contributed an estimated 14,638 (SE = 459) fish to the Central District driftnet fishery, 1,760 (SE = 263) to the Central District eastside setnet fishery, and 7,757 (SE = 199) to the Northern District setnet fishery.

An escapement of 1,001 coho salmon into Ship Creek and 1,612 coho salmon into Campbell Creek exceeded the biological escapement goal of 200 coho salmon for each creek. Estimates of effort, harvest, and catch from the Statewide Harvest Survey increased in 1996 relative to the 1988-1992 (prestocking) average at Ship, Campbell, and Bird creeks, likely due to the return of stocked coho salmon. A total of 275 coho salmon with decodable tags were recovered from escapements to Northern Cook Inlet streams. Six (3.4%) of 174 tags recovered from the escapement into Ship Creek were from coho salmon not stocked into Ship Creek; therefore, straying into Ship Creek was likely > 2%.

Key words: coho salmon, *Oncorhynchus kisutch,* commercial harvest, sport harvest, escapement, coded wire tag, Northern Cook Inlet, stocking, straying.

INTRODUCTION

Upper Cook Inlet (UCI) includes all waters of Cook Inlet north of a line at the latitude of Anchor Point light. Coho salmon *Oncorhynchus kisutch* stocks are distributed throughout UCI and support large commercial and sport harvests. In 1996, approximately 35% of the total central region commercial harvest (ADF&G 1997) and 31% of the total statewide sport harvest (Howe et al. 1997) of coho salmon occurred in UCI. The primary UCI coho salmon commercial fisheries are: (1) Central District drift gillnet, (2) Central District Upper Subdistrict (eastside) set gillnet, and (3) Northern District set gillnet fisheries (Figure 1). The most popular directed sport fisheries in UCI are: Kenai River on the Kenai Peninsula, Susitna and Little Susitna rivers in Northern Cook Inlet, and Ship Creek in the Anchorage area (Howe et al. 1997).

The Northern Cook Inlet (NCI) urban area extends from Ingram Creek in Turnagain Arm north to the Little Susitna River drainage (Figure 2). Recreational fishing effort in this area increased from an average of about 183,400 angler-days from 1977-1986 to nearly 276,000 angler-days annually from 1987-1996 (Mills 1979-1994, Howe et al. 1995-1997). Anglers fishing in NCI target five species of Pacific salmon *Oncorhynchus*, rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, Arctic charr *S. alpinus,* Arctic grayling *Thymallus arcticus*, and northern pike *Esox lucius*. Sport fisheries for these species are supported by a combination of wild and hatchery-produced stocks.

As the NCI human population grows, the demand for sport fishing opportunities increase. Hatchery-produced stocks play an important role in supporting these growing sport fisheries as wild stocks become fully utilized. A coho salmon smolt stocking program was initiated in 1992 to increase recreational sport fishing opportunities in the NCI urban area, specifically in Bird,

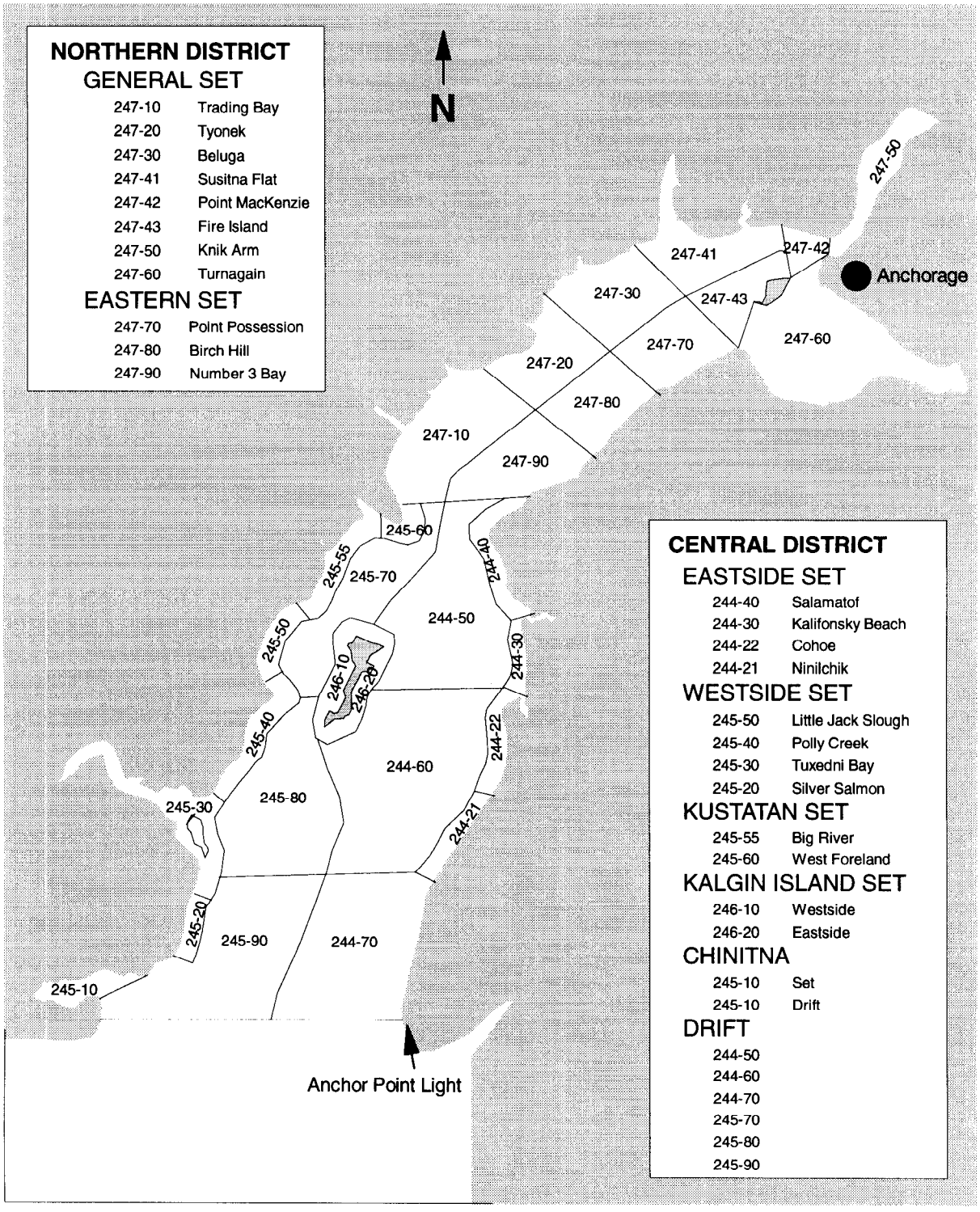


Figure 1.-Upper Cook Inlet commercial salmon fishing districts and statistical areas.

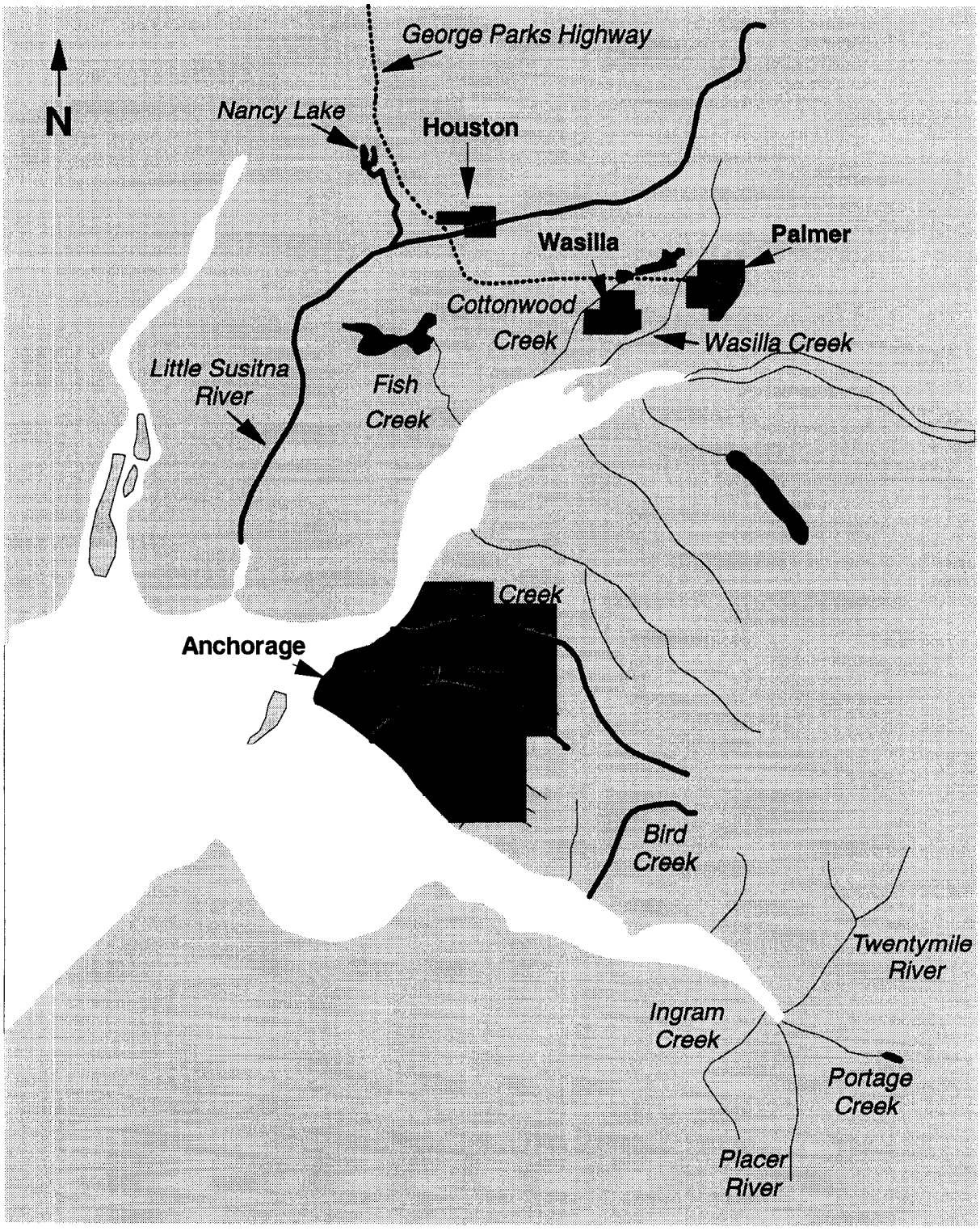


Figure 2.-Northern Cook Inlet urban areas. Streams stocked with coho salmon in 1995 are in bold.

Campbell, and Ship creeks. To succeed, the stocking program must be cost-effective, have minimal impact on wild stocks and/or other fisheries, and maintain historic levels of natural spawning escapements in stocked streams.

The goal of the program is to create or enhance terminal sport fisheries in selected NCI urban area streams and attract additional recreational fishing participation. The program is targeted to increase recreational angler effort by 25,000 angler-days and harvest by 10,000 coho salmon among all stocked streams. The Statewide Harvest Survey (SWHS) is used to evaluate increases in angler effort (for all species combined) and coho salmon harvest. In 1995 a portion of the smolt released into each stream were marked with an adipose finclip and a coded wire tag unique to each stream (Table 1).

Prior to the start of this program in 1992, there was no quantifiable information of stock composition from the mixed-stock commercial harvests and virtually no information on the magnitude of inriver runs or spawning escapements. To provide information needed to manage these fisheries, an assessment program was initiated in 1991 to evaluate coho salmon stocks in UCI (Meyer et al. *Unpublished*). This program was designed to estimate harvest of selected wild and hatchery-reared coho salmon stocks in major UCI commercial fisheries and to evaluate the success of the coho salmon hatchery stocking programs in NCI. The overall program consists of four distinct but interrelated components: (1) estimation of commercial and inriver sport harvests and escapement of coho salmon stocked in NCI streams; (2) marking of wild stock juvenile coho salmon, inriver recovery of marked adults, and estimation of UCI commercial harvests of coho salmon from the Kenai River; (3) estimation of sport harvest and escapement, and evaluation of the coho salmon stocking program at Little Susitna River; and (4) production, marking, and release of coho salmon smolt by the hatcheries.

This report focuses on the first component above and primarily on results of coho salmon stocked in 1995 that returned to UCI in 1996. The remaining three program components are reported elsewhere (Carlon and Hasbrouck 1993, 1996, 1997, *In prep*; Bartlett 1996a, 1996b; Whitmore and Sweet 1997; Peltz and Starkey 1993; Peltz and Hansen 1994; Starkey et al. 1995-1997). In 1996 the NCI coho salmon project was in its fourth year. Results from 1993, 1994, and 1995 programs can be found in Hoffmann and Hasbrouck (1994), Stratton et al. (1996), and Cyr et al. (1997).

OBJECTIVES

Objectives for the 1996 urban coho salmon assessment fall into two categories: escapement and commercial catch sampling.

Escapement objectives were as follows:

1. Enumerate the coho salmon spawning escapement through a weir at Ship Creek.
2. Test the null hypothesis that hatchery-produced coho salmon stocked into Campbell Creek do not stray into Ship Creek upon return.
3. Index coho salmon spawning escapements in Bird and Campbell creeks using foot surveys, and selected Twentymile and Placer river drainages and Portage Creek tributaries using a combination of foot and aerial surveys.

Table 1.-Summary of coded wire tagging data by release site for coho salmon reared at Fort Richardson hatchery and stocked in Northern Cook Inlet streams, 1995.

	Bird Creek	Campbell Creek	Nancy Lake	Ship Creek	Totals
Tag Codes	31-23-37	31-23-36	31-23-39	31-23-38	
Total marked and tagged[a]	45,743	45,771	46,334	45,580	183,428
Mortalities	77	116	73	89	
Marked fish released	45,666	45,655	46,261	45,491	183,073
Tag retention sample size	777	761	774	761	
Tag retention at release	99.6%	98.6%	97.8%	98.2%	
Tag retention variance	4.96E-06	1.87E-05	0.00003	0.00002	
Tagged fish released	45,490	44,995	45,245	44,654	180,384
Tagged fish variance	10,336	39,070	59,472	49,172	
Total fish released	154,753	157,241	151,985	158,981	622,960
Percent tagged	29.5%	29.0%	30.4%	28.6%	29.0%
Theta[b]	0.294	0.286	0.297	0.281	0.289
Tagging dates	11/10/94 11/17/94	10/19/94 10/26/94	10/26/94 11/2/94	11/3/94 11/9/94	
Date of tag retention check	5/19/95	5/19/95	5/17/95	5/18/95	
Days elapsed[c]	183	205	196	190	

Taken from: Starkey et al. 1996.

[a] Marked refers to fish with an adipose finclip, tagged refers to fish with an adipose finclip and a coded wire tag.

[b] Calculated using proportion of tagged fish in total fish released.

[c] Number of days between last tagging date and tag retention check date.

Commercial harvest objectives were as follows:

1. Estimate harvest in the Northern District setnet fishery, the Central District Upper Subdistrict (eastside) setnet fishery, and the Central District driftnet fishery of hatchery-produced coho salmon stocked into NCI urban streams.

Data collected from other components of the overall UCI coho salmon assessment program are also pertinent to this project. Coho salmon were examined for missing adipose fins from the escapement at the Little Susitna River weir (upstream of the George Parks Highway) during the coho salmon egg take at the hatchery release site (Nancy Lake, located downstream of the George Parks Highway), and from the sport harvest at Little Susitna River. Data collected from the Little Susitna River project were used in this report to assess straying. Results of the coho salmon hatchery stocking program in Little Susitna River can be found in Whitmore and Sweet (1997).

METHODS

STUDY DESIGN

This project was designed to estimate the harvest in the UCI mixed-stock commercial fishery of hatchery-produced coho salmon stocked into NCI streams and to estimate the total run of stocked fish to Bird, Ship, and Campbell creeks and Little Susitna River.

Coho salmon smolt were marked by inserting a coded wire tag into their snout and removing their adipose fin. Marked smolt were mixed and released with unmarked smolt into each stream. Catch sampling programs of adult coho salmon in the commercial harvest and the escapement were conducted in 1996 to recover marked fish. Heads were collected from coho salmon missing the adipose fin and sent to the Alaska Department of Fish and Game (ADF&G) Coded Wire Tag Laboratory (Tag Lab) in Juneau. The Tag Lab determined if a tag was present and decoded recovered tags to determine year and stream of release. Catch sampling data were used to test assumptions of the model, to estimate harvest of marked cohorts, and determine the necessary stratification that provided an unbiased estimate of harvest with the best precision. Final estimates of harvest and their variances were then calculated. Survival of hatchery-reared coho salmon from smolt to adult was estimated.

DATA COLLECTION

Stocking and Marking

Coho salmon from Little Susitna River were used as brood stock for 1995 hatchery releases into Bird, Ship, and Campbell creeks and Nancy Lake. Nancy Lake drains into the Little Susitna River via Nancy Lake Creek approximately 5 miles downstream of the George Parks Highway. Nancy Lake is the hatchery release and brood stock collection site for Little Susitna River; hereafter coho salmon released into Nancy Lake will be referred to as Little Susitna River stock. Gametes collected in 1993 from coho salmon in Nancy Lake were fertilized, then incubated, and the resultant fry reared at ADF&G's Fort Richardson Hatchery. The subsequent smolt were stocked in 1995 (Starkey et al. 1996) and returned as adults in 1996. Prior to 1995 coho salmon from Ship Creek were used as brood stock for stocking in Ship Creek and reared at ADF&G's Elmendorf Hatchery.

A portion of smolt from each release cohort was marked with an adipose finclip and a uniquely numbered coded wire tag inserted in their snout. The tagging goal of 40,000 smolt per release

stream was exceeded for all releases in 1995 (Table 1). The cohorts recovered in 1996 were primarily from 1995 releases and ranged from 151,985 smolt released into Little Susitna River to 158,981 smolt released into Ship Creek (Table 1). Details of the rearing, marking, and release of hatchery-stocked coho salmon are discussed in detail by Starkey et al. (1996).

Escapement

A fish pass with a live box, hereafter called a weir, was used to enumerate the coho salmon escapement into Ship Creek. The weir was located above the instream sport fishery and the total number of coho salmon passed through the weir was assumed to equal the entire escapement. The Ship Creek weir was operated from 17 July through 20 September (Appendix A1). The weir was in operation 24 hours a day on the days it was open. At least once per day all coho salmon that entered the live box were counted and examined for a missing adipose fin. Counts of other salmon species were recorded. The weir was often closed during weekends and for one or two days before and after the weekends once the biological escapement goal (BEG) was reached on 31 July. Salmon fishing is only allowed in the area of creek below the weir; thus, closing the weir granted sport anglers a greater opportunity to maximize the harvest of surplus hatchery fish by preventing fish passage upstream into closed waters during busy weekend periods.

Heads were collected from some of the coho salmon with missing adipose fins that passed through the Ship Creek weir to test the hypothesis on straying. Given the expected number of coho salmon in the escapement and the need to collect a minimum of 158 coho salmon with coded wire tags to test the hypothesis of straying, heads were systematically collected from every third coho salmon missing the adipose fin. To assure attaining the targeted sample size, the number of heads collected increased to every second fish and sometimes every fish as the Ship Creek coho salmon run peaked. This level of sampling allowed us to test the straying hypothesis while ensuring that the BEG would be met. A uniquely numbered cinch strap was affixed to the jaw of each coho salmon head collected. Each head was placed in an individual clear plastic bag with the cinch strap number visible. Collected data included: date, creek, number of coho salmon examined, number of coho salmon missing the adipose fin, number of heads collected from coho salmon missing their adipose fin, and the cinch strap number of each head collected. All heads with cinch straps were returned to the Anchorage ADF&G office and frozen until shipment to the Tag Lab.

A weir was operated on the Little Susitna River upstream of the George Parks Highway (Whitmore and Sweet 1997) to enumerate the coho salmon escapement. A portion of the escapement was examined for missing adipose fins. Coho salmon were also enumerated and examined for missing adipose fins during the Nancy Lake egg take when coho salmon were collected using seine nets. Data collected from this project were also used to assess straying.

A single foot survey conducted during peak spawning was used to index coho salmon escapements in both Bird and Campbell creeks. Multiple foot and aerial surveys were conducted to index wild stock coho salmon escapements in selected Twentymile and Placer river drainages and selected Portage Creek tributaries. Peak coho salmon counts were used as the final tally.

Commercial Harvest Sampling

Sampling of the UCI commercial coho salmon harvest was conducted from mid-July to early September 1996. Coho salmon were sampled on sorting lines at processors, at buying stations, or on-board tenders. All regular commercial fishing periods (7:00 a.m. to 7:00 p.m., Mondays

and Fridays) that occurred from mid-July through early September in the Central District driftnet and eastside setnet fisheries and the Northern District setnet fishery were sampled. Additional Central District fishing periods (as allowed through emergency order) were sampled as time and budget allowed.

Coho salmon delivered to processors, buying stations, or tenders were counted and examined for the absence of the adipose fin. As many fish as possible were examined from deliveries during the sampling shift. All coho salmon observed with a missing adipose fin were retrieved, the head removed, and a uniquely numbered cinch strap affixed to the head. Each head was placed in an individual clear plastic bag with the cinch strap number visible. Collected data included: date of harvest, date of sampling, processor, delivery location, name of tender or buying station, statistical area, number of coho salmon examined, number of coho salmon missing their adipose fin, number of heads collected from coho salmon missing their adipose fin, and the cinch strap number of each head collected. All coho salmon heads with cinch straps were returned to ADF&G offices in Soldotna or Anchorage. The heads were frozen and shipped weekly to the Tag Lab for tag removal and decoding. After each commercial fishing period, the preliminary commercial harvest of coho salmon in UCI by statistical area was obtained from Division of Commercial Fisheries Management and Development (CFMD) staff in Soldotna. Final commercial harvest data by statistical area and date were obtained on 12 December 1996.

In general, totes sampled from setnet harvested coho salmon were of fish harvested in a single statistical area. Thus, the total harvest and catch sample data could be summarized by statistical area. Totes of coho salmon sampled from the Central District driftnet fishery were a mixture of fish harvested in different statistical areas. Thus, harvest and catch sample data from the Central District driftnet fishery were combined for statistical areas 244-50, 244-60, 244-70, 245-70, 245-80, and 245-90.

Northern District

The Northern District is subdivided into 11 statistical areas (Figure 1). By regulation, commercial fishing periods occur between 7:00 a.m. and 7:00 p.m. on Mondays and Fridays from 25 June until closed by emergency order (5 AAC 21.320, *Weekly Fishing Periods*). Additional fishing periods are allowed and/or regularly scheduled periods may be closed by emergency order; however, no additional fishing periods may be allowed after 15 August (5 AAC 21.363, *Upper Cook Inlet Management Plan*). Only set gillnet gear is allowed in Northern District waters (5 AAC 21.330, *Gear*). Statistical area 247-50 is only opened through emergency order (5 AAC 21.364, *Fish Creek Sockeye Salmon Management Plan*) and statistical area 247-60 is closed to commercial fishing (5 AAC 21.350, *Closed Waters*).

Coho salmon processed in the Anchorage area during 1996 were composed entirely of fish harvested in Northern District statistical areas. Three technicians and one student intern stationed in Anchorage sampled commercial harvests with efforts concentrated at two shorebased processors, North Alaska Fisheries and Great Pacific Seafoods. Some sampling also occurred at Alaska Smoked Salmon International. Setnet harvests from statistical areas 247-70, 247-80, and 247-90, purchased by Cook Inlet Processors in Nikiski, were sampled regularly by personnel from Soldotna. Some coho salmon harvested from statistical areas 247-10, 247-20, and 247-30 were sampled at Icicle Seafoods in Homer by Soldotna-based technicians. We needed to examine 35% of the harvest of each Northern District statistical area in order to achieve the desired accuracy and precision of chosen objectives. Harvest from the Northern District was

sampled in Anchorage from 15 July through 23 August, in Homer from 15 July through 13 August, and in Nikiski from 26 July until 7 September. After these dates commercial fishing effort in the respective fisheries dropped to near zero levels. Technicians contacted processors throughout the season to coordinate sampling logistics and to ensure that all possible fish were examined.

Central District

The Central District driftnet fleet operates in seven statistical areas and the setnet fishery occurs in 13 statistical areas (Figure 1). Coho salmon harvested by driftnet were sampled from six statistical areas (244-50, 244-60, 244-70, 245-70, 245-80, and 245-90) and those harvested by setnet were sampled from four statistical areas (244-21, 244-22, 244-30, and 244-40) composing the Upper Subdistrict (eastside) fishery. We needed to examine 25% of the Central District driftnet harvest, and 15% of the coho salmon harvested from each Central District Upper Subdistrict setnet statistical area in order to achieve the desired accuracy and precision of chosen objectives.

Commercial fishing periods of both the driftnet and Upper Subdistrict setnet fisheries occur between 7:00 a.m. and 7:00 p.m. on Mondays and Fridays (5 AAC 21.320, *Weekly Fishing Periods*). Additional fishing periods are allowed through emergency order and regularly scheduled periods may be closed by emergency order. The *Upper Cook Inlet Management Plan* (5 AAC 21.363) restricts the dates of the setnet fishery from 4 July through 15 August. Several management plans affect time and area closures or openings of both fisheries (5 AAC 21.358, *Northern District Coho Salmon Management Plan;* 5 AAC 21.359, *Kenai River Late Chinook Salmon Management Plan;* 5 AAC 21.360, *Kenai River Sockeye Salmon Management Plan;* 5 AAC 21.361, *Russian River Sockeye Salmon Management Plan;* 5 AAC 21.363, *Upper Cook Inlet Management Plan;* and 5 AAC 21.365, *Kasilof River Sockeye Salmon Special Harvest Area Management Plan*).

Most coho salmon harvested from the Central District driftnet and Upper Subdistrict setnet fisheries as well as some coho salmon harvested by Northern District setnet fisheries were processed at facilities on the Kenai Peninsula. Commercial catch sampling of these coho salmon harvests was conducted under the supervision of CFMD biologists in Soldotna. Sampling of the driftnet harvest occurred at Carlson Seafoods, Cook Inlet Processing, Dragnet Fisheries, Icicle Seafoods, Inlet Salmon, Pacific Star, Royal Pacific Fisheries, Salamatof Seafoods, Snug Harbor Seafoods, Trans-Aqua International, and Wards Cove Packing. The Upper Subdistrict setnet harvest was sampled at buying stations of major fish processors. These processors included: Cook Inlet Processing, Deep Creek, Dragnet Fisheries, Fishhawk Fisheries, Icicle Seafoods, Inlet Salmon, Pacific Star, R & J Seafoods, Royal Pacific Fisheries, Salamatof Seafoods, Snug Harbor, Trans-Aqua International, and Wards Cove Packing.

The driftnet harvest was sampled by six technicians from 1 July through the closing date of 9 August. The harvest of the Upper Subdistrict setnet fishery was sampled by four technicians from 12 July until the fishery closed on 12 August.

DATA ANALYSIS

Straying

The potential exists for hatchery-reared and released anadromous fish to stray from stream of release into a different stream upon return. Therefore, a null hypothesis that stocked coho

salmon did not stray from the stream of stocking upon return was tested. A chi-square statistic was used to test the null hypothesis such that a stray rate of 2% (J. Seeb, ADF&G, Anchorage, personal communication) could be detected. A consistent level of straying ≥ 2% over a 4-5 year period would be considered unacceptable. Only recoveries from the Ship Creek escapement were used for this test. A sample of 158 decodable tags from heads collected at the Ship Creek weir was sufficient for this test. If all 158 tagged coho salmon recovered at the weir were originally stocked in Ship Creek, then the straying rate was likely < 2%. If one or more of the 158 tagged coho salmon was stocked into a different creek, then the straying rate was likely ≥ 2%.

Estimating Commercial Harvest of Stocked Coho Salmon

Estimating the commercial harvest of a cohort required determining the proportion of fish marked with a coded wire tag and adipose finclip. The proportion of tagged coho salmon stocked at each location was assumed known prior to release (Starkey et al. 1996). However, if significant tag loss occurred after release the proportion of tagged coho salmon was estimated by sampling the inriver return of adults.

A chi-square statistic was used to test the hypothesis that tag retention at return and release was the same. Tag retention data prior to smolt release and adult recovery data from Ship Creek escapement and Nancy Lake egg take were used for the test.

Harvest of a single marked cohort (release group) of fish in a stratum was estimated by (Bernard and Clark 1996):

$$\hat{r}_{ij} = N_i \theta_j^{-1} \left(\frac{m_{ij}}{\lambda_i n_i} \right), \tag{1}$$

where:

N_i = total number of fish harvested in stratum i,

θ_j = proportion of cohort j marked and released with a coded wire tag,

m_{ij} = number of decoded coded wire tags from cohort j in stratum i,

n_i = number of fish in stratum i sampled for a missing adipose fin,

λ_i = $\frac{t_i' a_i'}{t_i a_i}$, which is the decoding rate of coded wire tags from marked fish sampled in stratum i,

a_i = number of fish sampled in stratum i missing their adipose fin,

a_i' = number of heads from a_i that arrived at the Tag Lab,

t_i = number of heads from a_i' with coded wire tags detected, and

t_i' = number of tags from t_i that are decoded.

This estimator is statistically unbiased when sampling is from a simple random or pseudo-random process (Bernard and Clark 1996).

If tag retention at return was not statistically different from tag retention at time of release, the proportion of marked coho salmon in each cohort at time of release was treated as a known constant. When the harvest (N_i) and the proportion marked (θ_j) are known without error the large-sample approximation of an unbiased estimate of the variance is:

$$\hat{V}(\hat{r}_{ij}) = \frac{\hat{r}_{ij}}{\lambda_i \phi_i \theta_j}(1 - \lambda_i \phi_i \theta_j), \tag{2}$$

where: $\phi_i = \frac{n_i}{N_i}$.

Values of harvest from the fish ticket database are assumed known and measured without error. No significant differences were found in tag retention between 1995 releases from the hatchery and 1996 adult escapement samples at Ship Creek ($\chi^2 < 0.01$, df = 1, P = 0.99) or egg take samples at Nancy Lake ($\chi^2 = 0.65$, df = 1, P = 0.42) (Table 2). The values of θ at the time of release (Starkey et al. 1996) were used and treated as known values measured without error for all 1995 releases.

Harvest of each cohort was stratified by date and statistical area for each sampled fishery. Statistical area was unknown when catch sampling the Central District driftnet fishery so harvest of this fishery was stratified only by date. The total harvest of a cohort in a fishery was estimated by summing the estimates among the strata. Variance of the total estimate was also calculated by summing the variances of the strata estimates since strata were assumed independent and there were no additional covariance terms.

Table 2.-Number of coded wire tagged coho salmon sampled (n) and tag retention (%) prior to release in 1995 and at recovery in Northern Cook Inlet escapements, 1996.

	Release[a]		Recovery	
Release Site	n	%	n	%
Ship Creek	761	98.2	165	98.2
Little Susitna River[b]	774	97.8	101	99.0[c]

[a] Starkey et al. 1996.

[b] Nancy Lake egg take recoveries.

[c] Tag retention greater at recovery than at release due to sampling error. Rates are not significantly different ($x^2 = 0.65$, df = 1, P = 0.42).

Total harvest of marked cohorts and their variances were estimated with the data stratified and with the data combined to determine if data could be combined among statistical areas of setnet harvested coho salmon, particularly in the Northern District. For example, to determine if three statistical areas could be combined, estimates calculated with the data stratified by statistical area and then summed were compared to the estimate with data from the three statistical areas combined. A z-test was used to determine if there were significant differences between estimates from stratified data and pooled data. If the estimates of harvest were not significantly different and combining the data improved the precision of the estimate, the data were combined. Otherwise, estimates were stratified.

RESULTS

ESCAPEMENT

In 1996, 301 of the 1,191 coho salmon counted at the weir on Ship Creek were missing their adipose fin (Table 3, Appendix A1). A total of 178 heads were collected from coho salmon missing their adipose fin and sent to the Tag Lab. Heads were not taken from an additional 12 coho salmon missing their adipose fin that were donated to the "Becoming an Outdoors Woman Workshop." The remaining 1,001 coho salmon were passed through the weir. The contribution of hatchery fish to the Ship Creek weir was calculated from tag recovery data. An estimated 997 (SE = 52) coho salmon to the weir were stocked into Ship Creek (980 were stocked as smolt in 1995, 15 were from smolt stocked into Ship Creek in 1994, and 2 were from smolt stocked into Ship Creek in 1993). An estimated 30 (SE = 12) coho salmon to the weir were originally stocked into Campbell Creek as smolt in 1995 and 6 (SE = 5) were originally stocked into Little Susitna River as smolt in 1995. The remaining 158 were from natural production.

Of 12,932 coho salmon passed through the Little Susitna River weir, 460 were examined for a missing adipose fin. No coho salmon missing the adipose fin were seen and no heads were collected. A total of 365 coho salmon were examined at Nancy Lake during the coho salmon egg take (Table 3). Of the sampled coho salmon, 104 were missing the adipose fin. Heads were collected from all fish missing the adipose fin and sent to the Tag Lab. All decodable tags were of coho salmon released into Little Susitna River (Nancy Lake) in 1995.

The coho salmon escapement index into Campbell Creek on 30 September was 1,612 fish (Appendix A2). A coho salmon escapement index conducted on 19 September in Bird Creek and Penguin Creek (a tributary of Bird Creek) tallied 169 coho salmon (Appendix A2). In October, a total of 1,245 and 530 coho salmon were observed in surveys of Twentymile and Placer (including sloughs and Skookum Creek) river drainages, respectively (Appendix A3). A total of 192 coho salmon were observed in selected Portage Creek sloughs and streams (Appendix A3). Turnagain Arm escapement surveys were conducted later in the season because peak spawning of these native coho salmon stocks is generally 3-6 weeks later than streams stocked with Little Susitna brood stock.

STRAYING

A total of 275 decodable tags were recovered from coho salmon escapements monitored at Ship Creek and Nancy Lake (Table 4). Of the 174 coho salmon recovered with tags from the Ship Creek escapement, six (3.5%) were from fish not originally stocked into Ship Creek. Five of the coded wire tags were from fish originally stocked into Campbell Creek in 1995 and one coded

Table 3.-Sample effort for marked fish in coho salmon escapements in monitored Northern Cook Inlet streams, 1996.

Stream	Examined for missing adipose fins	Observed with missing adipose fins	Heads collected	Decodable Tags	Total Through Weir	Weir Operation Dates[a]
Little Susitna River[b]	365	104	104	101	365	9/23-10/08
Ship Creek	1,191	301	178	174	1,013	7/17-9/20

[a] Ship Creek starting date is date first coho salmon was passed through weir. For Little Susitna River, dates represent time period when egg takes occurred.

[b] Coho salmon examined were from Nancy Lake egg take. Terry Bradley, ADF&G, Palmer, personal communication.

Table 4.-Number of coho salmon with decodable coded wire tags recovered from monitored Northern Cook Inlet escapements by release site, 1996.

	Recovery Site		
Release Site	Little Susitna River[a]	Ship Creek	Total Recoveries
Campbell Creek	0	5	5
Little Susitna River[b]	101	1	102
Ship Creek	0	168	168
Kenai River	0	0	0
Total	101	174	275

[a] Nancy Lake egg take recoveries. Terry Bradley, ADF&G, Palmer, personal communication.

[b] Little Susitna River brood stock released into Nancy Lake. Terry Bradley, ADF&G, Palmer, personal communication.

wire tag was from a fish stocked into Little Susitna River in 1995. Therefore, straying into Ship Creek of coho salmon stocked into Campbell Creek was > 2%. No straying was detected from the 101 coho salmon recovered with tags from the Nancy Lake egg take. Finally, no straying was detected from 504 tags recovered from the Kenai River sport harvest (Carlon and Hasbrouck *In prep*).

COMMERCIAL HARVEST OF STOCKED COHO SALMON

A total of 321,411 coho salmon were harvested in (UCI) mixed-stock fisheries in 1996 (Table 5). A combined total of 288,204 coho salmon were harvested in the sampled fisheries (Table 6). Catch sampling did not occur over the entire fishing season; however, only 6% of the overall UCI coho salmon harvest in the selected fisheries occurred on days not sampled. Harvest on days not sampled was combined with the nearest day the harvest was sampled to estimate harvest of marked cohorts for the entire season.

Technicians examined 30% of the total harvest for sampled UCI fisheries and 4% of the fish examined had a missing adipose fin. In the Northern District, 61% of the coho salmon harvested were examined for a missing adipose fin. In the Central District, 24% were sampled in the driftnet and 17% were examined in the eastside setnet fisheries. It was possible to sample a greater proportion of the Northern District harvest than the Central District harvest because fewer processors purchased fish, there were fewer fishing periods, and all fishing periods were scheduled openings rather than a combination of scheduled and emergency order openings.

The majority of samples collected from the commercial setnet harvest in statistical areas 247-10, 247-20, and 247-30 and in statistical areas 247-70, 247-80, and 247-90 were mixed loads. Based on z-tests of 1996 data ($|z| \geq 0.51$, $P \geq 0.31$) and historical treatment of these statistical areas (Hoffmann and Hasbrouck 1994, Stratton et al. 1996, Cyr et al. 1997), we concluded combining data from 247-10, 247-20, and 247-30 together and data from 247-70, 247-80, and 247-90 together would not bias harvest estimates of stocked coho salmon. The majority of samples collected from statistical areas 247-41 and 247-42 were pure loads; however, several samples also had coho salmon harvests from the two statistical areas mixed. For 6 days when pure loads were sampled from 247-41 and 247-42, harvest estimates of stocked coho salmon were not significantly different ($|z| = 0.35$, $P = 0.73$) between data stratified by statistical area or with the data combined among the two areas. This same result occurred in 1995 (Cyr et al. 1997); therefore, data from 247-41 and 247-42 were combined in 1996.

These results indicated that combining harvest and sample data from statistical areas 247-10, 247-20, and 247-30; combining harvest and sample data from statistical areas 247-41 and 247-42; and combining harvest and sample data from statistical areas 247-70, 247-80, and 247-90, together, would not introduce significant bias in estimating commercial harvest of marked cohorts. Combining these statistical areas in this fashion also allowed the use of sample data from mixed loads collected from these areas. There was no pooling of statistical areas from the Central District eastside setnet fishery because precision of the estimates did not improve appreciably when the areas were combined. Therefore, harvest estimates of marked cohorts were stratified by statistical area and by date.

The majority of the UCI coho salmon harvest in the sampled fisheries occurred in the Central District driftnet fishery, followed by the Northern District setnet fishery, and the Central District eastside setnet fishery (Figure 3). Most of the coded wire tags recovered (Table 7) and most of

Table 5.-Commercial salmon harvest in Upper Cook Inlet, 1996.

Fishery	Statistical Area	Chinook	Sockeye	Coho	Pink	Chum	Total Catch	% Coho
Central District Drift								
General (East/West Sides)	245-70,80,90; 244-50,60,70	387	2,204,933	171,361	122,728	140,924	2,640,333	6%
Central District Set								
Westside								
Western, Kustatan	245-20,30,40,50,55,60	356	31,871	15,616	365	1,294	49,502	32%
Kalgin Island	246-10,20	39	64,503	15,559	3,426	880	84,407	18%
Chinitna Bay	245-10	0	345	230	1	140	716	32%
Total		395	96,719	31,405	3,792	2,314	134,625	23%
Eastside								
Ninilchik	244-21	3,065	298,664	8,404	15,393	235	325,761	3%
Cohoe	244-22	2,561	280,169	7,644	19,699	493	310,566	2%
Kalifornski	244-30	3,960	369,745	7,595	23,426	208	404,934	2%
Salamatof	244-40	1,935	534,420	16,905	37,199	512	590,971	3%
Total		11,521	1,482,998	40,548	95,717	1,448	1,632,232	2%
Central District total		12,303	3,784,650	243,314	222,237	144,686	4,407,190	6%
Northern District Set								
Westside								
Trading Bay	247-10	103	2,093	3,902	156	321	6,575	59%
Tyonek	247-20	540	21,525	27,416	8,267	6,035	63,783	43%
Beluga	247-30	955	9,408	13,695	6,014	3,514	33,586	41%
Susitna Flat	247-41	45	3,107	3,112	262	151	6,677	47%
Pt. MacKenzie	247-42	128	3,893	3,351	581	289	8,242	41%
Fire Island	247-43	71	5,713	8,375	3,122	697	17,978	47%
Knik Arm	247-50	0	35,245	1,802	25	448	37,520	5%
Total		1,842	80,984	61,653	18,427	11,455	174,361	35%
Eastside								
Pt. Possession	247-70	73	11,926	6,945	1,161	294	20,399	34%
Birch Hill	247-80	10	4,560	4,584	295	8	9,457	48%
Number 3 Bay	247-90	20	6,658	4,915	791	14	12,398	40%
Total		103	23,144	16,444	2,247	316	42,254	39%
Northern District setnet total		1,945	104,128	78,097	20,674	11,771	216,615	36%
Upper Cook Inlet total		14,248	3,888,778	321,411	242,911	156,457	4,623,805	7%

Table 6.-Commercial coho salmon harvest, harvest dates, and sampling dates for sampled Upper Cook Inlet fisheries, 1996.

Fishery	Statistical Area	Catch dates	Total coho catch	Sampling date	Catch during sampling	Sampled[a]
Central District Drift	244, 245	6/28-8/09	171,361	7/01-8/09	167,095	98%
Central District Set						
Ninilchik	244-21	6/28-8/12	8,404	7/12-8/12	6,954	83%
Cohoe	244-22	6/28-8/12	7,644	7/12-8/12	5,990	78%
Kalifornski	244-30	6/28-8/12	7,595	7/12-8/12	6,067	80%
Salamatof	244-40	7/01-8/12	16,905	7/12-8/12	14,521	86%
Eastside setnet total			40,548		33,532	83%
Northern District Set						
Westside	247-10,20,30	6/28-8/23	45,013	7/15-8/12	41,889	93%
Susitna Flats/Pt. MacKenzie	247-41,42	6/28-8/26	6,463	7/15-8/26	6,145	95%
Fire Island	247-43	7/05-8/19	8,375	7/15-8/19	8,304	99%
Eastside	247-70/80/90	6/28-9/06	16,444	7/15-9/6	14,534	88%
Northern setnet total			76,295		70,872	93%
Upper Cook Inlet total			288,204		271,499	94%

[a] Percentage of total coho harvest represented by sampling.

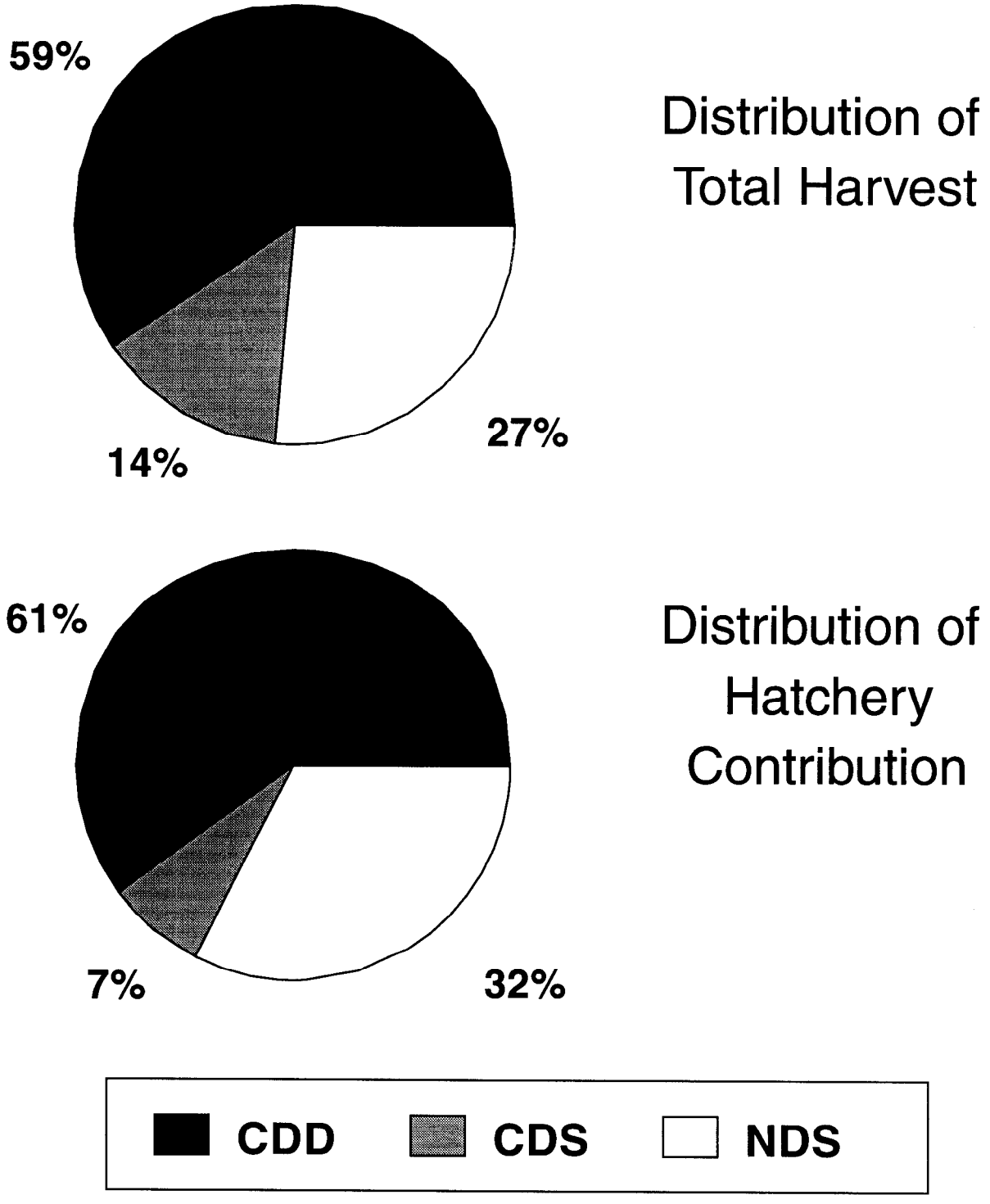


Figure 3.-Distribution of coho salmon harvest and hatchery contribution among three Upper Cook Inlet fisheries: Central District driftnet (CDD), Central District setnet (CDS), and Northern District setnet (NDS), 1996.

Table 7.-Harvest, sampling data, and coded wire tag recoveries for selected Upper Cook Inlet commercial coho salmon fisheries, 1996.

Fishery	Catch during sampling	Number of coho observed	Number of heads collected	1993 Release Sites	1994 Release Sites		1995 Release Sites				Tag not detected	Tag/Head lost	Total[a]
				Fish Creek	Ship Creek	Bird Creek	Ship Creek	Bird Creek	Campbell Creek	L. Susitna River			
Central District													
Driftnet	167,095	41,478	1,326	1	0	1	264	287	273	255	83	6	1,170
Eastside Setnet													
Ninilchik	6,954	1,058	110	0	0	0	0	0	3	3	1	8	15
Cohoe	5,990	1,450	111	0	0	0	2	7	2	4	6	5	26
Kalifornski Beach	6,067	1,074	80	0	0	0	3	6	4	5	4	7	29
Salamatof	14,521	3,352	227	0	0	0	10	7	11	11	10	3	52
Eastside Beach Total	33,532	6,934	528	0	0	0	15	20	20	23	21	23	122
Central District Total	200,627	48,412	1,854	1	0	1	279	307	293	278	104	29	1,292
Northern District													
Westside[b]	41,889	28,888	277	0	0	0	71	39	38	88	36	5	277
Susitna Flat/Pt. MacKenzie[c]	6,145	4,721	494	0	0	0	176	71	125	90	30	2	494
Fire Island	8,304	7,387	1,003	0	0	0	294	218	375	63	50	3	1,003
Eastside[d]	14,534	6,411	62	0	1	0	15	16	15	4	7	0	58
Northern District Total	70,872	47,407	1,836	0	1	0	556	344	553	245	123	10	1,832
Upper Cook Inlet Total	271,499	95,819	3,690	1	0 1	1	835	651	846	523	227	39	3,124

[a] Total does not include heads collected with Kenai River or Deep Creek coded wire tags.

[b] Combination of statistical areas 247-10, 247-20, and 247-30.

[c] Combination of statistical areas 247-41, and 247-42.

[d] Combination of statistical areas 247-70, 247-80, and 247-90.

the harvest of hatchery-produced coho salmon occurred in the Central District driftnet and Northern District setnet fisheries (Tables 8 and 9, Figure 3). Overall, stocked coho salmon represented 8% (SE = 0.2%) of the total UCI coho salmon commercial harvest (Table 10, Figure 4). When estimated by fishery, 9% (SE = 0.3%) of the Central District driftnet fishery, 4% (SE = 0.6%) of the Central District Eastside setnet, and 10% (SE = 0.3%) of the Northern District setnet harvests were composed of hatchery-produced fish (Table 10, Figures 5, 6, and 7).

The 1995 smolt releases into three Anchorage urban area streams (Bird, Campbell, and Ship creeks), and Little Susitna River were the largest contributors of hatchery fish to the commercial harvest (Table 11).

Returning adult coho salmon stocked into Bird, Campbell, and Ship creeks and Little Susitna River that were harvested in the sampled fisheries were primarily taken by the Central District drift fleet, followed by the Northern District setnet fishery, and the Central District Eastside setnet fishery (Figure 8). Over 85% of the coho salmon stocked into Bird, Campbell, and Ship creeks and Little Susitna River were harvested in the aforementioned fisheries from 14 July to 5 August (Appendices B4-B12). In the Northern District, fish stocked into Bird, Campbell, and Ship creeks were primarily harvested around Fire Island (247-43) and in the Susitna Flats (247-41) and Pt. MacKenzie (247-42) statistical areas near Anchorage. The majority of coho salmon stocked into Little Susitna River were harvested along the west (247-10, -20, -30) side of the Northern District, and both Point MacKenzie (247-42) and Susitna Flats (247-41). The returns of Ship Creek 1995 stocked coho salmon composed 28% (6,765 coho salmon) of the hatchery returns in all sampled commercial fisheries (Figure 4). Coho salmon stocked into Campbell Creek in 1995 provided 27% (6,456 coho salmon), hatchery releases into Bird Creek in 1995 provided 24% (5,770 coho salmon), and coho salmon stocked into Little Susitna River in 1995 provided 21% (5,132 coho salmon) each of hatchery returns in all sampled fisheries (Figure 4). Contributions to the sampled commercial fisheries from 1993 and 1994 smolt releases into Bird, Ship, and Fish creeks can be found in Appendices B1-B3.

RETURNS

Total returns of coho salmon to urban area streams are made up of three measurable components: spawning escapement, commercial harvest, and inriver sport harvest (Table 12). The spawning escapement and estimates of commercial harvest are presented in this report. Total inriver sport harvest was estimated by the SWHS (Howe et al. 1997). Approximately 53% of Ship Creek hatchery returns, 45% of Bird Creek hatchery returns, 75% of Campbell Creek hatchery returns, and 57% of Little Susitna River hatchery returns were harvested by the commercial fishery (Figure 9).

Inseason observations of the sport fishery in the Anchorage urban streams indicated that the coho salmon stocking program met expectations. Estimates from the SWHS (Howe et al. 1997) indicated sport harvest, catch, and effort estimates for 1996 increased at Ship and Bird creeks but declined at Campbell Creek compared to 1995 (Figure 10). Differences in sport harvest, catch, and effort in Campbell Creek were most likely a result of coho salmon holding in Campbell Lake downstream of the area open to sport fishing until late in the fishing season. Total effort in Bird, Campbell, and Ship creeks exceeded 79,000 angler-days in 1996 compared to the 1988-1992

Table 8.-Estimated harvest ($\hat{r}_{ij}$) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Central District commercial fisheries, 1996

Stocked Into	Release Year	Central District Fishery										Setnet Total		Central District Total	
				East Side Setnet											
		Drift[a]		Ninilchik[b]		Cohoe[c]		Kalifonski[d]		Salamatof[e]					
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE
Little Susitna River	1995	3,360	219	94	76	61	33	91	40	344	109	590	142	3,950	261
Ship Creek	1995	3,702	232	0	0	35	27	53	31	397	184	485	189	4,187	299
Bird Creek	1994	6	6	0	0	0	0	0	0	0	0	0	0	6	6
	1995	3,837	234	0	0	146	59	93	37	103	45	342	83	4,179	248
	Total	3,843	234	0	0	146	59	93	37	103	45	342	83	4,185	248
Campbell Creek	1995	3,711	232	54	34	35	27	70	35	184	60	343	82	4,054	246
Fish Creek	1993	22	21	0	0	0	0	0	0	0	0	0	0	22	21
Total	1993	22	21	0	0	0	0	0	0	0	0	0	0	22	21
	1994	6	6	0	0	0	0	0	0	0	0	0	0	6	6
	1995	14,610	458	148	83	277	77	307	72	1,028	227	1,760	263	16,370	529
	Total	14,638	459	148	83	277	77	307	72	1,028	227	1,760	263	16,398	529

[a] Includes statistical areas 244-50, 244-60, 244-70, 245-70, 245-80, and 245-90.

[b] Statistical area 244-21.

[c] Statistical area 244-22.

[d] Statistical area 244-30.

[e] Statistical area 244-40.

Table 9.-Estimated harvest ($\hat{r}_{ij}$) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Northern District commercial fisheries, 1996.

Stocked Into	Release Year	Northern District Fishery								Northern District Total	
		West Side[a]		Su Flat/Pt. MacKenzie[b]		Fire Island[c]		East Side[d]			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE
Little Susitna River	1995	488	52	415	40	211	26	68	50	1,182	86
Ship Creek	1994	0	0	0	0	0	0	4	4	4	4
	1995	362	41	823	58	1,221	68	172		2,578	116
	Total	362	41	823	58	1,221	68	176	60	2,582	116
Bird Creek	1995	196	31	347	38	874	55	178	59	1,595	95
Campbell Creek	1995	201	32	587	49	1,477	72	139	35	2,404	99
Total	1994	0	0	0	0	0	0	4	4	4	4
	1995	1,247	80	2,172	94	3,783	116	557	104	7,759	199
	Total	1,247	80	2,172	94	3,783	116	561	104	7,763	199

[a] Includes statistical areas 247-10, 247-20, and 247-30.

[b] Includes statistical areas 247-41 and 247-42.

[c] Statistical area 247-43.

[d] Includes statistical areas 247-70, 247-80, and 247-90.

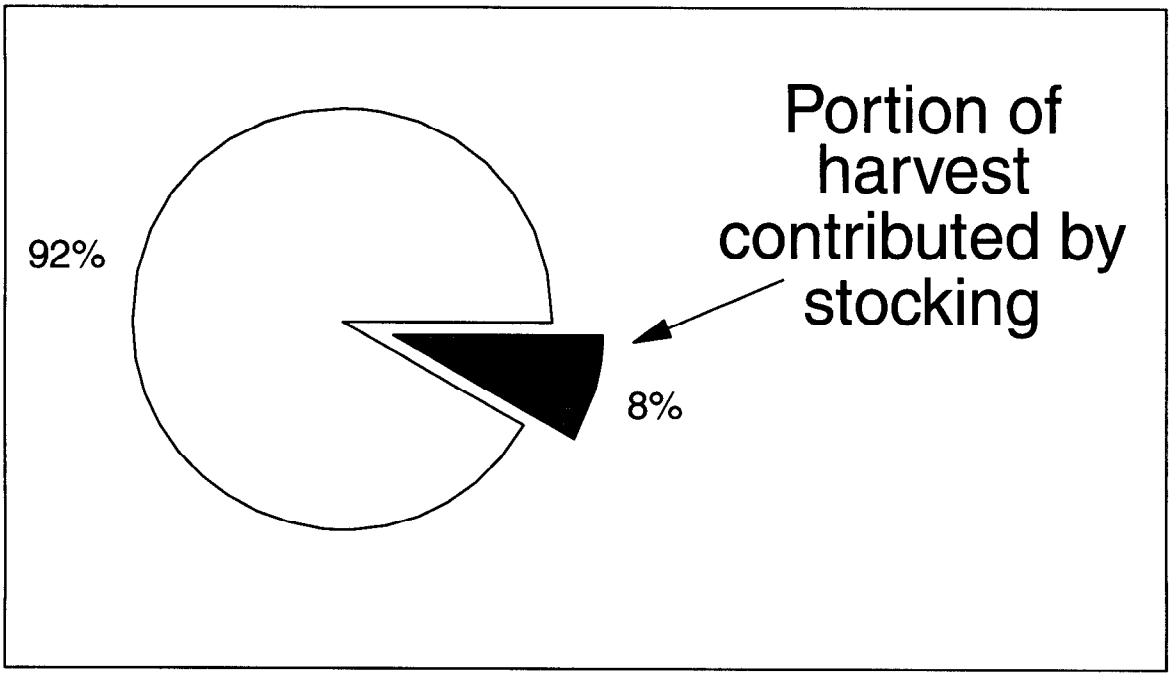
Table 10.-Estimated harvest ($\hat{r}_{ij}$) and standard error (SE) of Northern Cook Inlet hatchery-produced coho salmon by release year in sampled commercial fisheries, 1996.

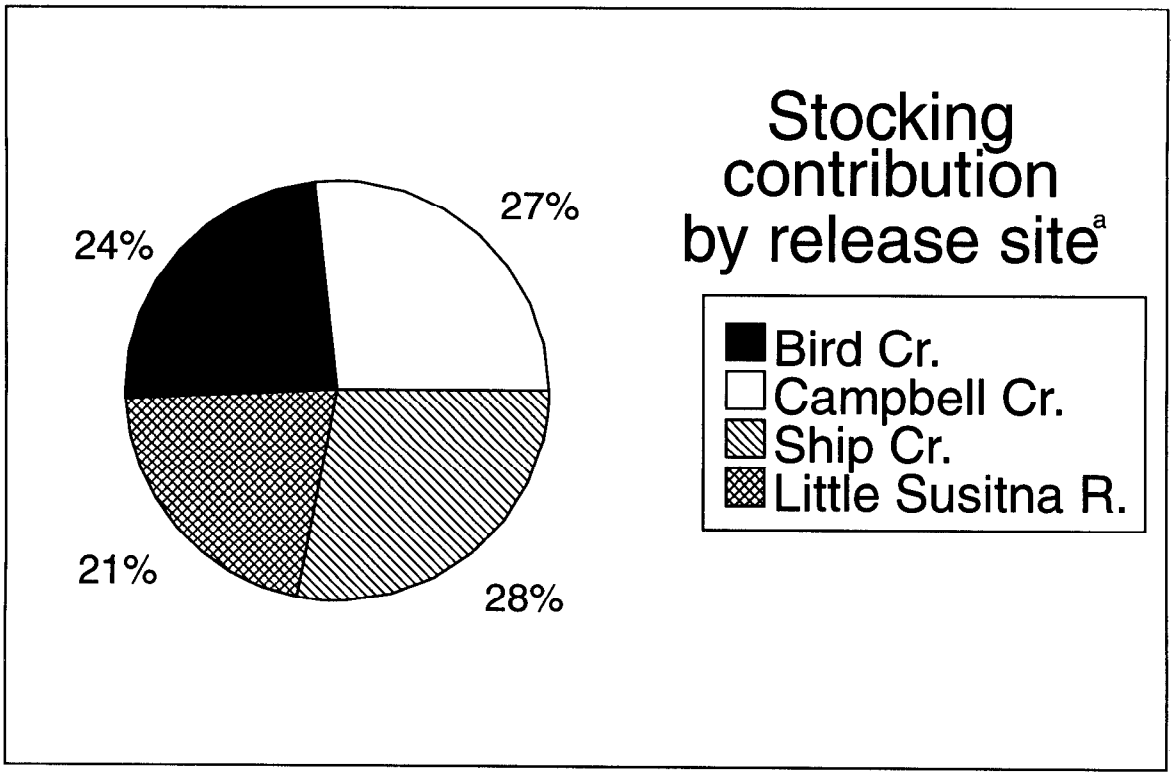
Sampled Fishery	Statistical Area	Coho Catch	1993 Releases		1994 Releases		1995 Releases		Total			
			$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
Central District Drift[a]	244, 245	171,361	22	21	6	6	14,610	458	14,638	459	8.5%	0.3%
Central District Set												
Ninilchik	244-21	8,404	[c]		[c]		148	83	148	83	1.8%	1.0%
Cohoe	244-22	7,644	[c]		[c]		277	77	277	77	3.6%	1.0%
Kalifornski	244-30	7,595	[c]		[c]		307	72	307	72	4.0%	0.9%
Salamatof	244-40	16,905	[c]		[c]		1,028	227	1,028	227	6.1%	1.3%
Eastside setnet total		40,548					1,760	263	1,760	263	4.3%	0.6%
Northern District Set[b]												
Westside	247-10,20,30	45,013	[c]		[c]		1,247	80	1,247	80	2.8%	0.2%
Susitna Flats/Pt. MacKenzie	247-41,42	6,463	[c]		[c]		2,172	94	2,172	94	33.6%	1.5%
Fire Island	247-43	8,375	[c]		[c]		3,783	116	3,783	116	45.2%	1.4%
Eastern	247-70/80/90	16,444	[c]		4	4	557	104	561	104	3.4%	0.6%
Northern setnet total		76,295	[c]		4	4	7,759	199	7,763	199	10.2%	0.3%
Sampled Upper Cook Inlet fisheries total		288,204	22	21	10	7	24,129	565	24,161	565	8.4%	0.2%

[a] Excluding Chinitna Bay substat area.

[b] Excluding Knik Arm substat area.

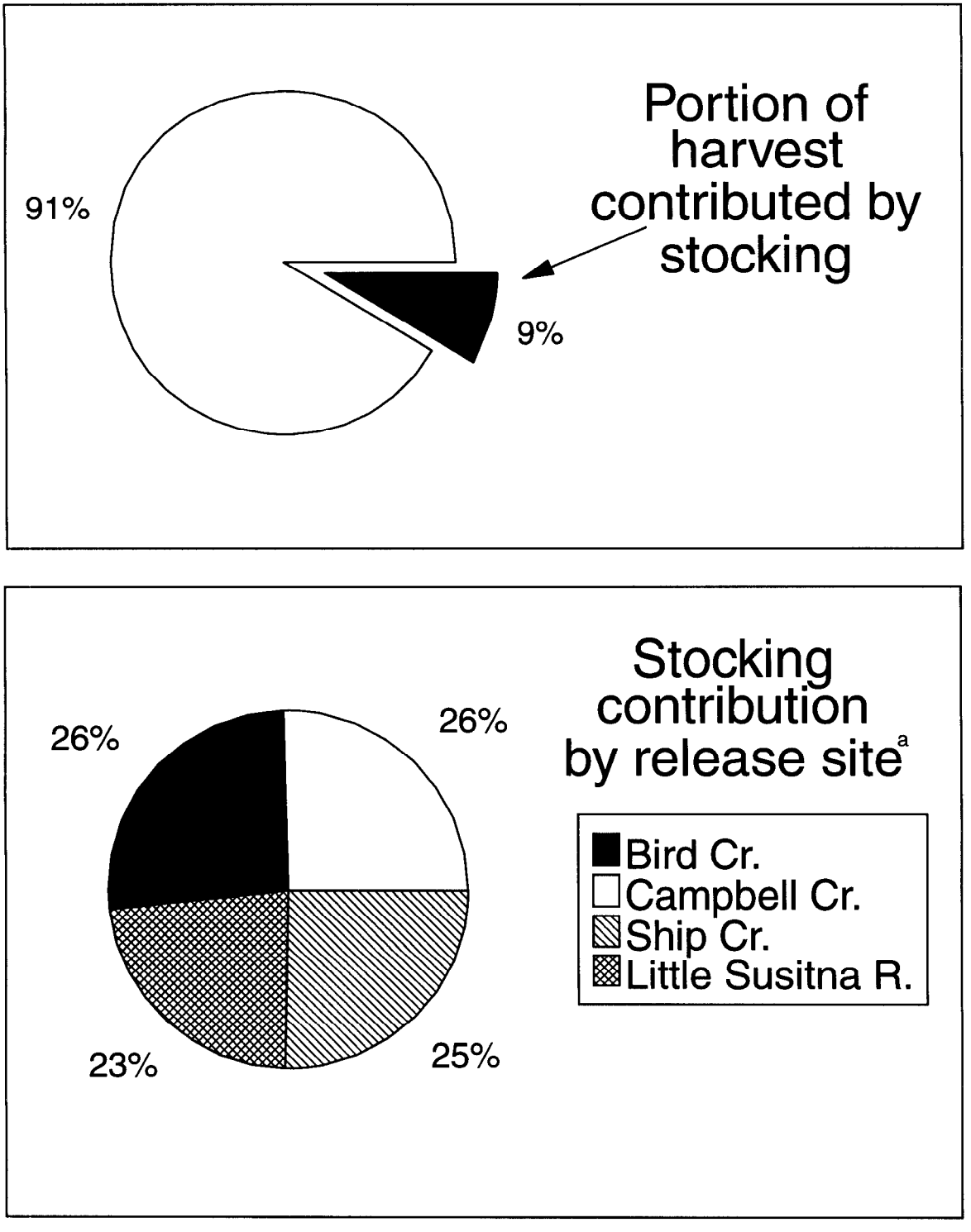
[c] No commercial recoveries.





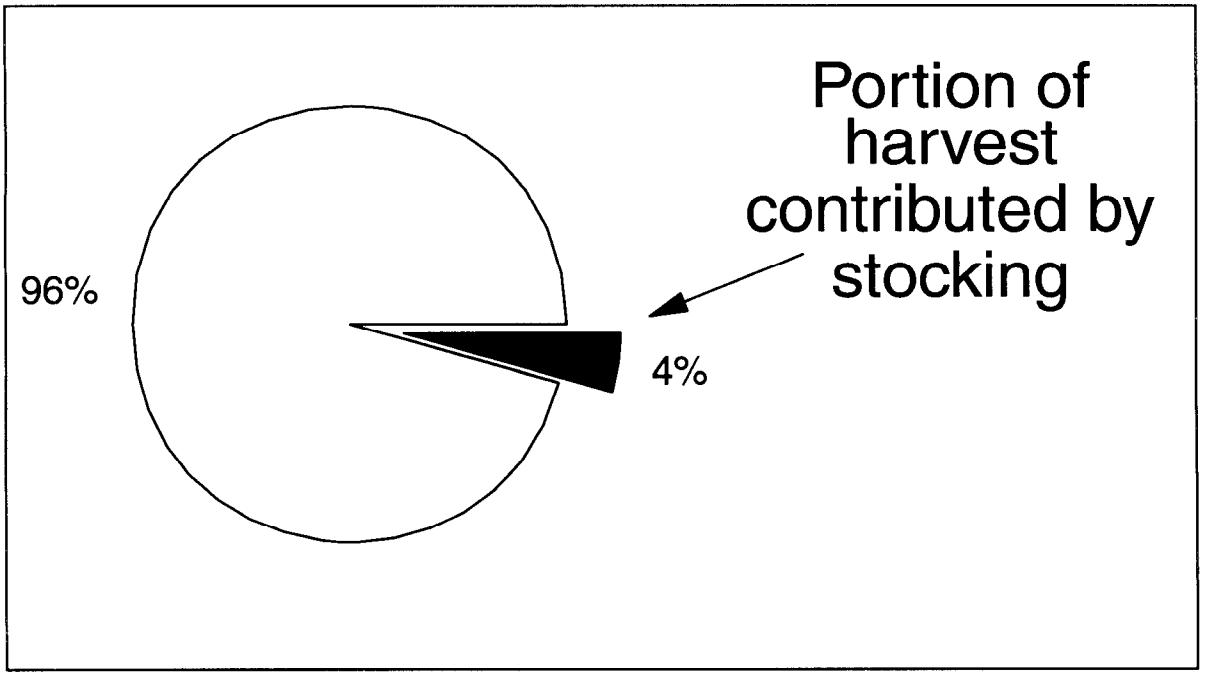
[a] 1993 Fish Creek release contribution is not included (less than 0.5%).

Figure 4.-Portion of 1996 Upper Cook Inlet coho salmon commercial harvest represented by urban stocked fish.



[a] 1993 Fish Creek release contribution is not included (less than 0.5%).

Figure 5.-Portion of 1996 Central District driftnet coho salmon commercial harvest represented by urban stocked fish.



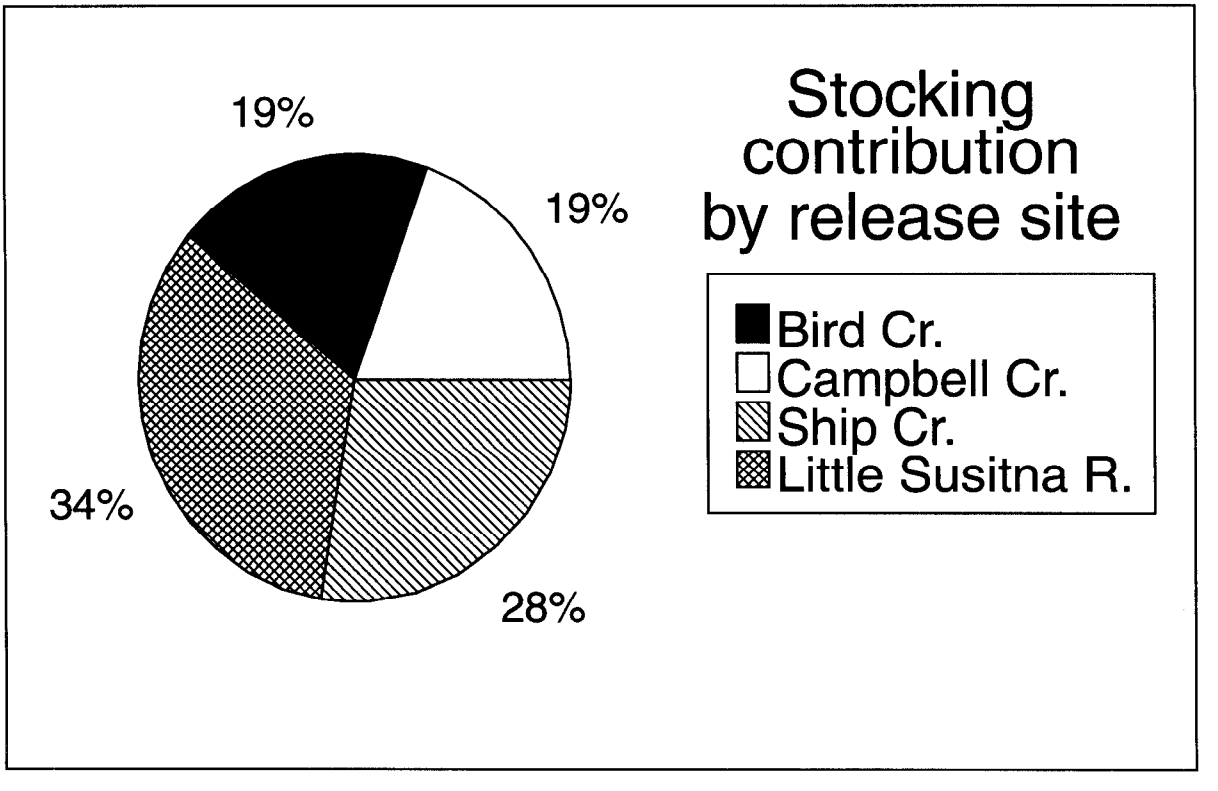
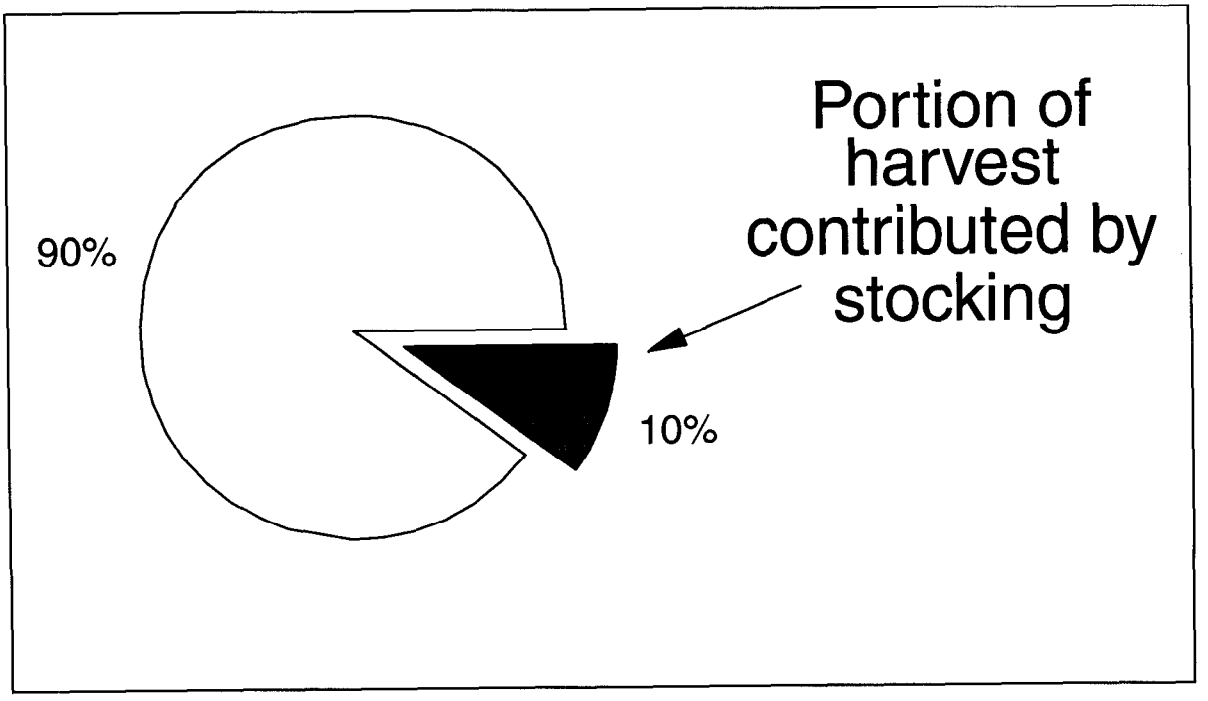


Figure 6.-Portion of 1996 Central District, Upper Subdistrict setnet coho salmon commercial harvest represented by urban stocked fish.



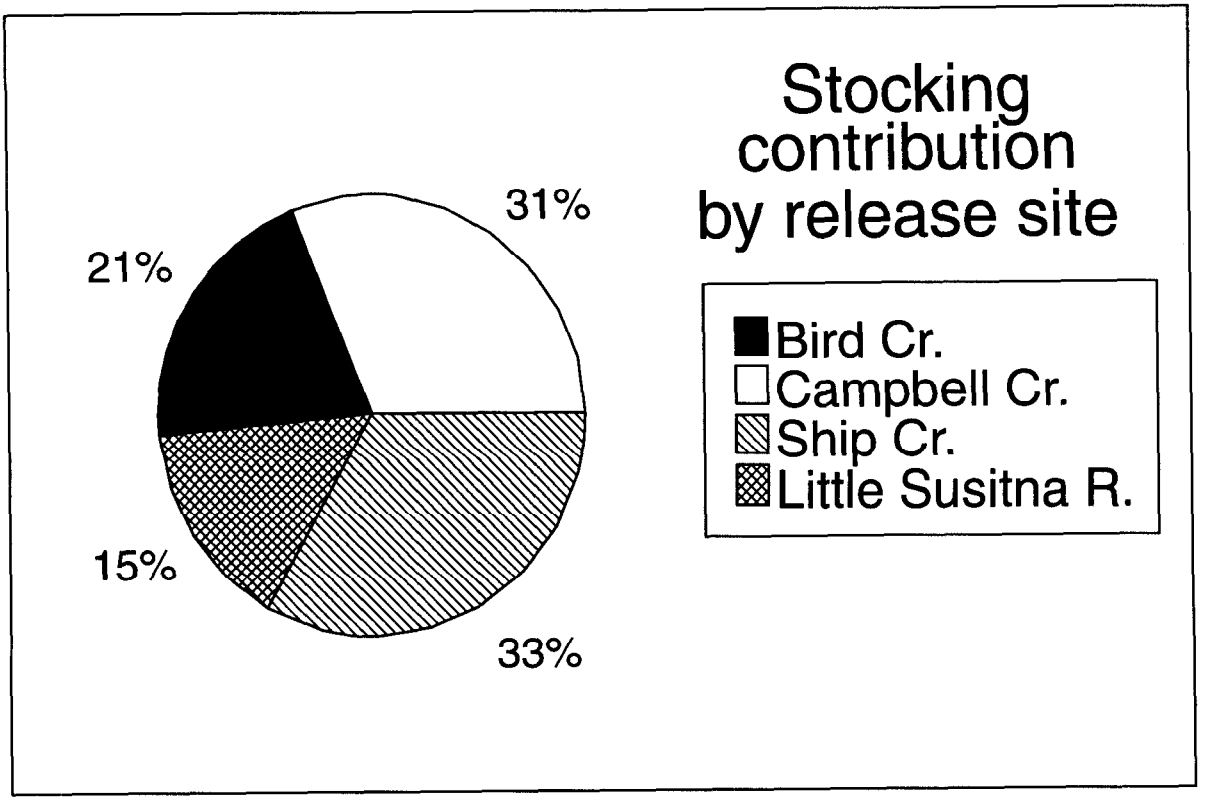


Figure 7.-Portion of 1996 Northern District setnet coho salmon commercial harvest represented by urban stocked fish.

Table 11.-Estimated harvest ($\hat{r}_{ij}$) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet commercial fisheries, 1996.

Stocked Into	Release Year	Central District[a] Driftnet $\hat{r}_{ij}$	Central District[a] Driftnet SE	East Side[b] Setnet $\hat{r}_{ij}$	East Side[b] Setnet SE	Northern District[c] Setnet $\hat{r}_{ij}$	Northern District[c] Setnet SE	Total $\hat{r}_{ij}$	Total SE
Little Susitna River	1995	3,360	219	590	142	1,182	86	5,132	275
Ship Creek	1994	0	0	0	0	4	4	4	4
	1995	3,702	232	485	189	2,578	116	6,765	321
	Total	3,702	232	485	189	2,582	116	6,769	321
Bird Creek	1994	6	6	0	0	0	0	6	6
	1995	3,837	234	342	83	1,595	95	5,774	265
	Total	3,843	234	342	83	1,595	95	5,780	265
Campbell Creek	1995	3,711	232	343	82	2,404	99	6,458	265
Fish Creek	1993	22	21	0	0	0	0	22	21
	1993	22	21	0	0	0	0	22	21
Total	1994	6	6	0	0	4	4	10	7
	1995	14,610	458	1,760	263	7,759	199	24,129	565
	Total	14,638	459	1,760	263	7,763	199	24,161	565

[a] Includes statistical areas 244-50, 244-60, 245-70, 245-80, and 245-90.

[b] Includes statistical areas 244-21, 244-22, 244-30, and 244-40.

[c] Includes 247-10, 247-20, 247-30, 247-41, 247-42, 247-43, 247-70, 247-80, and 247-90.

(prestocking) annual average of 34,700 angler-days. A total harvest and catch of 14,266 (SE = 1,294) and 20,533 (SE = 1,792) coho salmon, respectively, also occurred in the three stocked streams.

MARINE SURVIVAL

Overall marine survival of the four major coho salmon cohorts released in 1995 and recovered in 1996 was 6.9% (SE = 0.002; Table 13). Survival estimates ranged from 5.5% (SE = 0.3%) for smolt released into Campbell Creek to 8.4% (SE = 0.6%) for smolt released into Bird Creek. Estimated survival for smolt released at Ship Creek was 7.9% (SE = 0.5%) and for smolt released into Little Susitna River was 5.9% (SE = 0.3%). Depending on release site, escapements were indexed and sport harvests and escapements were not sampled. Therefore, estimates of the total run, and thus survival, of stocked coho salmon at Bird, Campbell, and Ship creeks and Little Susitna River are somewhat biased.

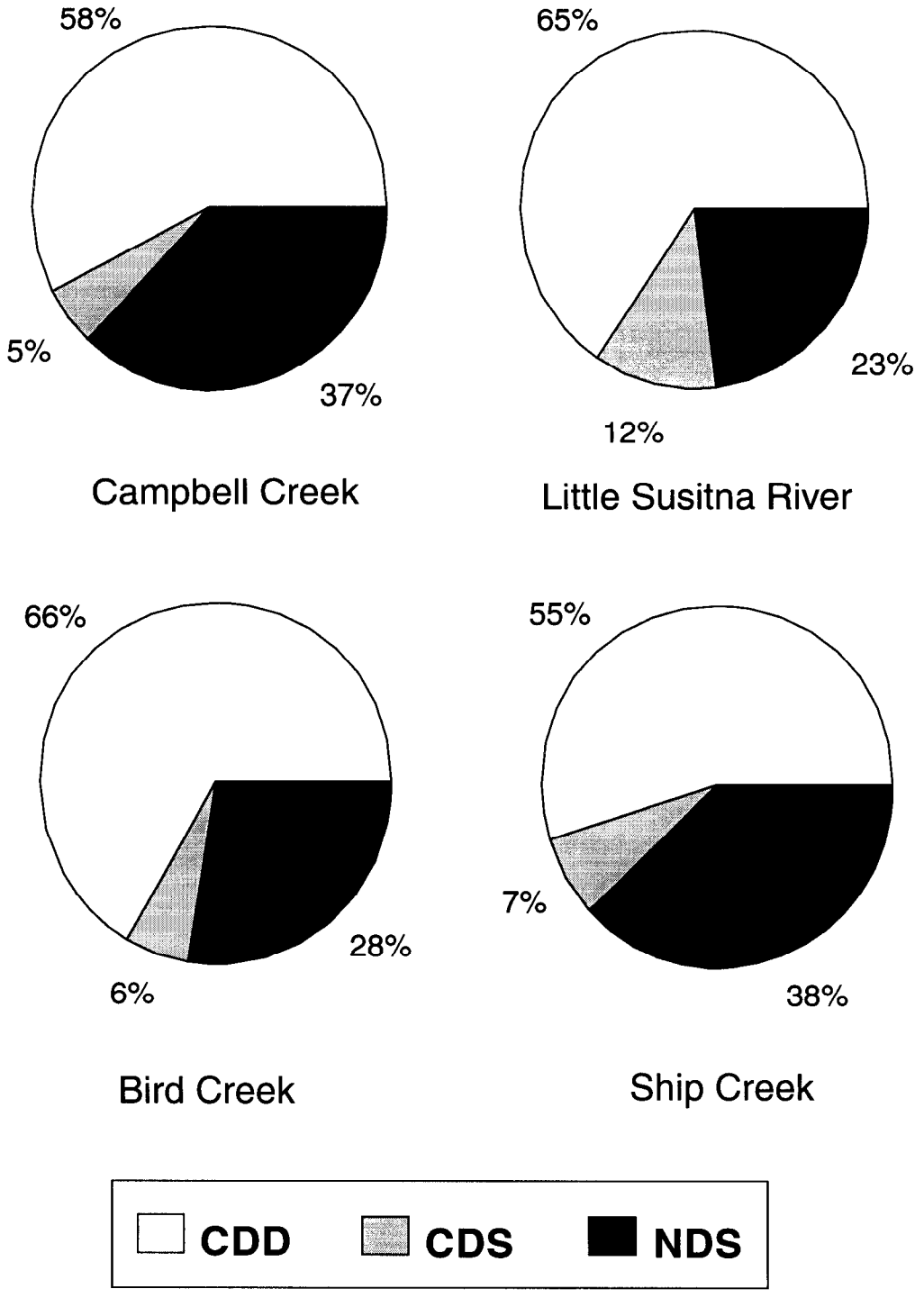


Figure 8.-Percent of the commercial harvest of each 1995 hatchery release group attributed to the Central District driftnet (CDD), Central District setnet (CDS), and Northern District setnet (NDS) fisheries, 1996.

Table 12.-Estimated hatchery and natural contributions to total coho salmon runs into Northern Cook Inlet stocked streams, 1996.

Stream		Hatchery Production 1993 releases Number	1994 releases Number	1995 releases Number	Total	%	Natural Production Number	Percent	Total Production Number	%
Bird Creek	Commercial Harvest	0	6	5,774	5,780	44.5%	unknown		5,780	44.5%
	Sport Harvest	unknown	unknown	unknown	7,029	54.2%	unknown		7,029	54.2%
	Escapement[a]	unknown	unknown	unknown	169	1.3%	unknown		169	1.3%
	Total	0	6	5,774	12,978	100%			12,978	100%
Campbell Creek	Commercial Harvest	0	0	6,458	6,458	74.9%	unknown		6,458	67.4%
	Sport Harvest	unknown	unknown	unknown	1,045	12.1%	465[c]	48.4	1,510	15.8%
	Escapement[a]	unknown	unknown	unknown	1,116	12.9%	496[c]	51.6	1,612	16.8%
	Total	0	0	6,458	8,619[b]	100%	961	100.0	9,580	100%
Ship Creek	Commercial Harvest	0	4	6,765	6,769	53.3%	unknown		6,769	49.6%
	Sport Harvest[d]	10	74	4,860	4,944	38.9%	783[e]	83.2	5,727	42.0%
	To Weir[f]	2	15	980	997	7.8%	158	16.8	1,155	8.5%
	Total	12	93	12,605	12,710	100%	941	100.0	13,651	100%
Little Susitna River	Commercial Harvest	0	0	5,132	5,132	57.3%	unknown		5,132	25.1%
	Sport Harvest	unknown	unknown	3,377	3,377	37.7%	11,485[h]		14,862	72.7%
	To Weir[i]	unknown	4	440	444	5.0%	unknown		444	2.2%
	Total	0	4	8,949	8,953[g]	100%	11,485		20,438	100%

[a] Estimated escapement index from foot surveys.

[b] Campbell Creek total does not include an estimated 30 coho salmon to the weir and an estimated 144 coho salmon to the sport harvest in Ship Creek.

[c] Contribution of natural production is calculated using proportion of natural production to Campbell Creek weir count in 1993 and 1994.

[d] Contribution of 1993, 1994, and 1995 hatchery releases calculated using proportion of 1993, 1994, and 1995 releases to the Ship Creek weir.

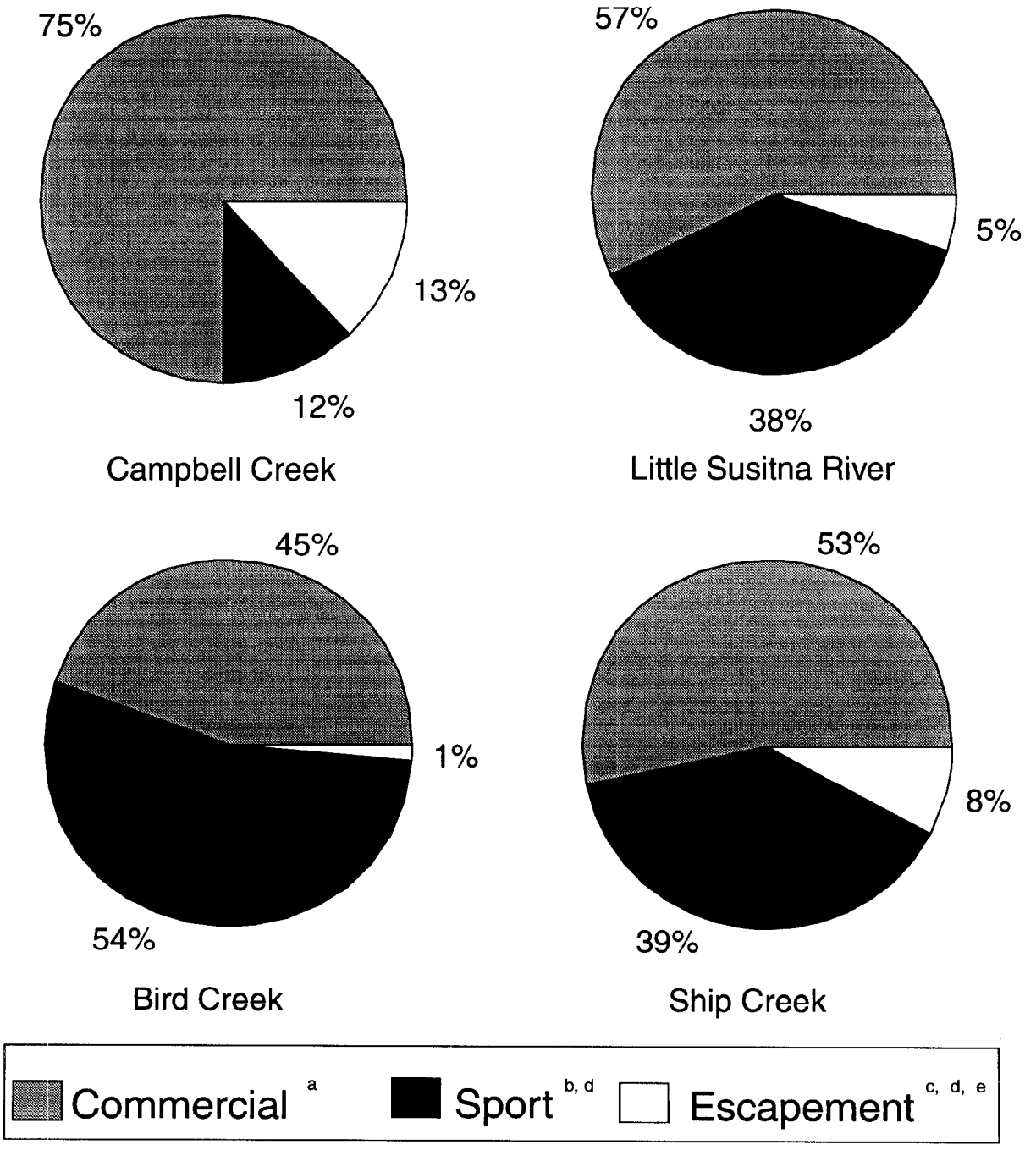
[e] Contribution of natural production is calculated using proportion of natural production to Ship Creek weir count.

[f] Total hatchery production estimate does not include Campbell Creek contribution of 30 coho salmon and Little Susitna River contribution of 6 coho salmon, therefore, estimates of hatchery production to Ship Creek weir are biased high.

[g] Contribution of hatchery and natural production is estimated using data collected during the Little Susitna River sport fishery catch sampling program.

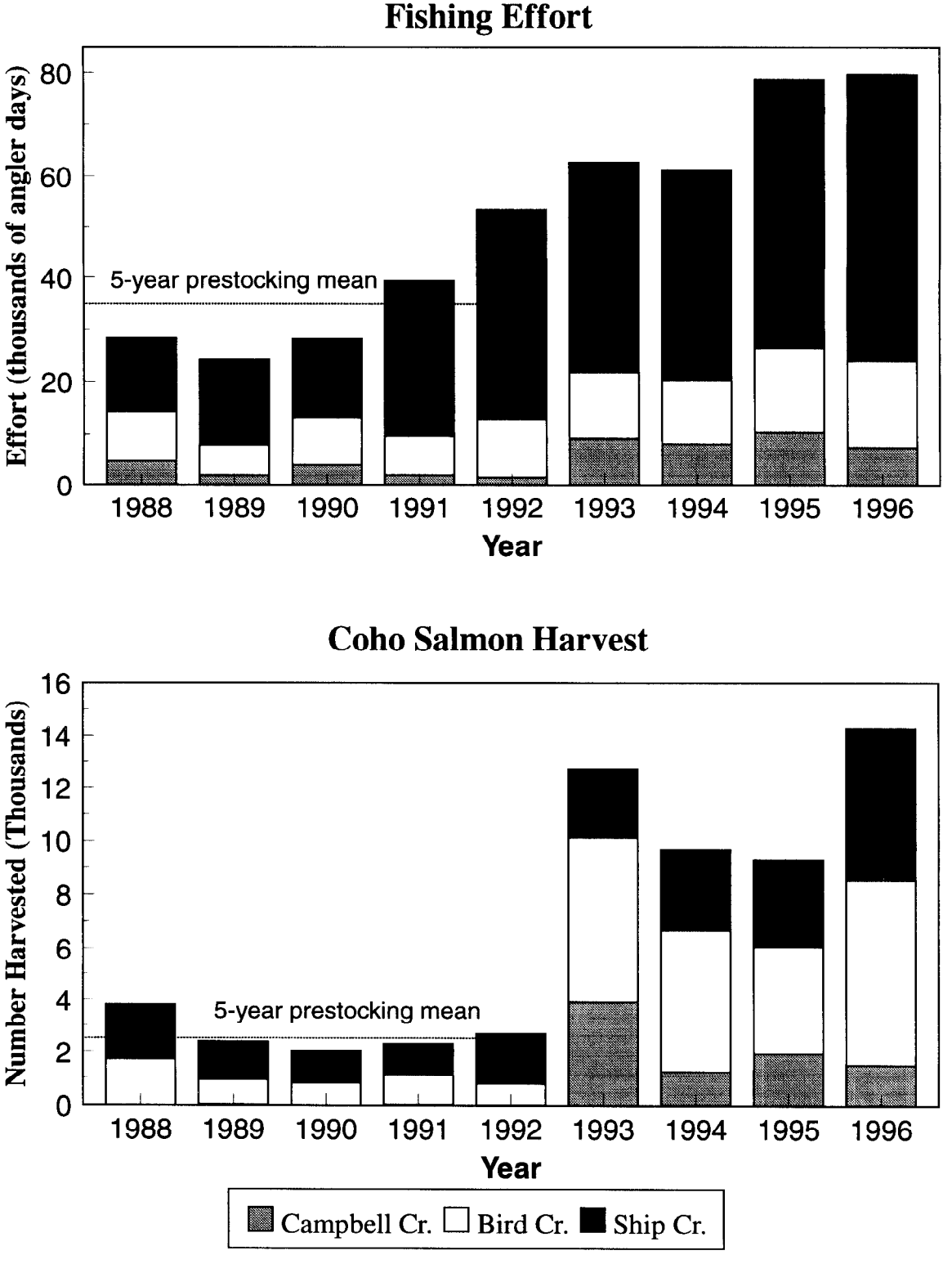
[h] Coho salmon examined were from Nancy Lake egg take, total production based on capture-recapture experiment and represents minimum number of coho salmon. Contribution of 1994 and 1995 hatchery releases calculated using proportion of 1994 and 1995 releases from CWT recoveries.

[i] Little Susitna total does not include an estimated 6 coho salmon to the weir and an estimated 29 coho salmon to the sport harvest in Ship Creek.



[a] Estimate of hatchery contribution to the UCI coho salmon commercial harvest from catch sampling data.
[b] Estimate of sport harvest of coho salmon from SWHS (estimated hatchery contribution not calculated for Bird Creek).
[c] Estimate of hatchery contribution to the escapement (Bird Creek is a minimum estimate of the total escapement from a foot survey).
[d] Estimates of hatchery contribution to Little Susitna River sport harvest from Little Susitna River sport fishery catch sampling data.
[e] Estimate of hatchery contribution to Little Susitna River escapement from Nancy Lake egg take data.

Figure 9.-Distribution of coho salmon total returns among commercial and sport fisheries and the escapement in four stocked streams.



Source: Mills 1989-1994, Howe et al. 1995-1997.

Figure 10.-Sport harvest and effort from 1988 to 1996 in Anchorage urban streams stocked with coho salmon.

Table 13.-Estimates and associated standard errors (in parenthesis) used to estimate marine survival of coho salmon stocked into Northern Cook Inlet streams in 1995 based on return data in 1996.

	Smolt Releases [a]		Commercial Harvest		Sport Harvest		Escapement		Total Return [b]		Estimated Smolt Survival	
Bird Creek	154,753	(3,714)	5,774	(265)	7,029 [c]	(905)	169 [d]		12,972	(943)	0.084	(0.006) [e]
Campbell Creek	157,241	(3,819)	6,458	(265)	1,045 [c]	(284)	1,116 [d]		8,619	(388)	0.055	(0.003) [e]
Ship Creek	158,981	(2,149)	6,765	(321)	4,860 [f]	(703)	980	(52)	12,605	(774)	0.079	(0.005)
Little Susitna River	151,985	(1,996)	5,132	(275)	3,377 [g]	(290)	440 [h]		8,949	(400)	0.059	(0.003) [e]
Total	622,960	(6,081)	24,129	(565)	16,311	(1,216)	2,705	(52)	43,145	(1,342)	0.069	(0.002) [e]

[a] Smolt releases and their SE's as reported by Starkey et al. 1996.

[b] Estimated total hatchery run of 1995 releases does not include any remaining adult coho salmon that are expected to return in low numbers in 1997.

[c] Total estimated harvest as reported in Howe et al. 1997. The predominant contribution to the harvest is from 1995 releases, though contributions from previous release years are assumed to be included.

[d] Escapement index from foot surveys - representing a minimal estimate of the total escapement. No estimate of sampling variability available.

[e] SE's of survival estimates assumed to be biased (too low) due to no estimates of sampling variance for estimated escapement.

[f] Contribution of 1995 releases calculated using proportion of 1995 releases to Ship Creek weir, applied to the harvest estimate reported by Howe et al. 1997.

[g] Contribution of hatchery production is estimated using data collected during the Little Susitna River sport fishery catch sampling program. The predominant contribution to the harvest is from 1995 releases, though contributions from previous release years are assumed to be included.

[h] Escapement based on coho salmon examined from Nancy Lake egg takes during capture-recapture experiment and represents a minimal estimate of the total escapement. No estimate of sampling variability available.

DISCUSSION

SPORT FISHERY

The NCI urban area coho salmon stocking program is considered successful if it results in an increase in recreational angler effort by 25,000 angler-days and sport harvest by 10,000 coho salmon among all stocked streams (Cyr et al. *Unpublished*). The prestocking 5-year mean (1988-1992) total effort in Ship, Campbell, and Bird creeks was 34,699 angler days with a mean harvest of 2,516 coho salmon. The targeted increase in harvest of 10,000 fish was achieved in 1996. Harvest increased by 11,750 coho salmon in 1996 relative to the prestocking 5-year mean. The estimated harvest is species specific so this increase is easily quantified. The ultimate measure of success, however, is increased angler effort. Statewide Harvest Survey estimates angling effort for all species combined. Increased angler effort for a specific species is not easily quantified and may be masked or exaggerated by fluctuations in effort of other fisheries. The targeted increase in angler effort of 25,000 angler-days was achieved with an increase of 44,621 angler-days of effort over the prestocking 5-year mean effort, and an increase of 25,940 angler-days of effort over effort in 1992, the last year before stocked fish returned. The true increase in angler effort for coho salmon may be masked by the continually increasing popularity of the chinook salmon fishery in Ship Creek. This fishery has grown dramatically in recent years and is included in the estimate of angler effort. In addition, a weakness of using the SWHS is that the survey targets licensed anglers. Field observations indicate that urban streams, especially Campbell Creek, are fished primarily by young anglers who are not required to purchase a license. Thus, estimates of harvest and effort in Campbell Creek are considered minimal estimates. Many coho salmon caught in Campbell Creek after the peak of the run are not retained. A substantial increase in the catch of coho salmon has occurred in Ship, Campbell, and Bird creeks since the start of the stocking program**.** The prestocking 3-year (SWHS did not estimate catch until 1990) mean catch for Ship, Campbell, and Bird creeks is 3,077 coho salmon. Catch increased by 17,456 coho salmon in 1996 relative to the prestocking 3-year mean. We believe results presented in this report and field observations of the sport fisheries indicate that the urban coho salmon stocking program exceeded all expectations in 1996.

In 1996 the Alaska Board of Fisheries (ABOF) adopted new regulations and modified the season and areas open to coho salmon sport fishing on Campbell Creek. Approximately ½ mile of creek from Lake Otis Parkway downstream to an ADF&G regulatory marker was closed to all fishing. Most land bordering this area of creek is privately owned and in the past land owners have had problems with trespassers and fish poaching. The ABOF closed this area in order to maintain public support for the continued development of the urban coho salmon hatchery stocking program in general, and the Campbell Creek program in particular. To mitigate the loss of fishing area below Lake Otis Parkway the upper boundary of the sport fishery was extended approximately ¼ mile from Folker Street upstream to an ADF&G regulatory marker. Opening this area of creek gives sport anglers a greater opportunity to take advantage of a harvestable surplus of coho salmon that often hold in areas of Campbell Creek at and upstream of Folker Street in August. The coho salmon sport fishing season was changed from an opening date of 25 July to 5 August from C Street bridge upstream to an ADF&G marker in the vicinity of Piper Street (except in the closed area). This change allowed chinook salmon in this area of creek 10 additional days to spawn while leaving the coho salmon sport fishery basically unaffected, as coho salmon historically do not reach this area until after 5 August. The sum of these changes

made by the ABOF helped to maintain the urban coho salmon stocking project objectives and protected spawning chinook salmon.

Past observations indicated that the majority of coho salmon often stay in the lower reaches of Campbell Creek or Campbell Lake from late July through mid to late August and move into the upper areas of the creek in late August or early September. In 1996 anglers concentrated their efforts primarily in the lower areas of Campbell Creek from C Street downstream to Dimond Boulevard in July and August. By late August and September most angler effort occurred from C Street upstream to the ADF&G marker near Piper Street. As in 1995 many of the fish stayed in Campbell Lake, which is closed to all sport fishing, until sexually mature and did not migrate upstream until late August and early September. Of the estimated 3,290 coho salmon caught by anglers at Campbell Creek in 1996 (Howe et al. 1997), about 54% (approximately 1,780) were released.

Hatchery coho salmon returning to Bird and Ship creeks were available from mid-July through late August. The peak of the run occurred during the last week of July through the first week of August. The fisheries in Bird and Ship creeks, being essentially intertidal, were more closely related to the tides than at Campbell Creek. Greatest success was during incoming and high tidal periods, although during the peak of the return, fish were available at all tide stages. Approximately 26% of the coho salmon caught in these two creeks were released and angler effort in 1996 was about 1,800 angler-days greater than that in 1995.

ESCAPEMENT

The Ship Creek BEG of 200 coho salmon was exceeded on 31 July when the weir count reached 239 fish. An emergency order was issued (effective 4 August) that increased the daily bag and possession limit of sport-caught coho salmon from three fish per day to six fish per day.

The Campbell Creek BEG of 200 coho salmon was exceeded on 11 September when a foot survey upstream of Lake Otis counted 286 coho salmon that had escaped the sport fishery. As a result of the survey, an emergency order was issued (effective 14 September) that increased the daily bag and possession limit of sport caught coho salmon from three fish per day to six fish per day. The final escapement count of 1,612 coho salmon in Campbell Creek was over eight times greater than the BEG indicating that returns from this stocking effort exceeded the needs of the fishery. To reduce run size, coho salmon stocking in Campbell Creek was reduced from 150,000 smolt to 75,000 smolt in 1996.

Prior to coho salmon stocking, Bird Creek had no natural spawning population of coho salmon, therefore, no BEG has been set for Bird Creek. Escapement indices of coho salmon into Bird Creek from 1993-1995 ranged from 139 to 593 fish.

Escapement counts were slightly greater in Bird, Campbell, and Ship creeks and Twentymile River compared to those in 1995. Coho salmon escapement counts in Portage Creek and Placer River drainages in 1996 were smaller than those in 1995. Greater escapement counts into Campbell, Ship, and Bird creeks were likely due to increased numbers of coho salmon stocked into these systems in 1995.

STRAYING

The straying of hatchery-reared coho salmon was examined because of concerns that hatchery fish may compete with wild stocks for spawning areas. Straying did occur in Ship Creek but no

straying was detected at the Little Susitna River. Straying into Ship Creek has been detected in past project years, however, the stray rate was not consistently ≥ 2%. The stray rate in 1993 was likely > 2%, in 1994 and 1995 the stray rate was likely < 2%. There is some question as to whether true straying does occur in Ship Creek. The weir at Ship Creek is located at the upper extent of the intertidal area. Salmon stay or mill in the mouths of nonnatal systems (Sandercock 1991), thus tagged fish released at Little Susitna River and Campbell Creek and recovered in Ship Creek may not have been destined to enter Ship Creek to spawn.

TAG LOSS

Tag loss was detected by the absence of coded wire tags in fish missing the adipose fin. A small percentage (<0.15%, Blankenship 1990) of possible naturally missing adipose fins in wild and hatchery-reared coho salmon indicate that the vast majority of coho salmon missing the adipose fin are coded wire tagged fish. Tag loss at Ship Creek and Little Susitna River was in the 1%-2% range both at release (Starkey et al. 1996) and as estimated from escapement and egg take samples. Therefore, tag loss of most release cohorts was assumed relatively low after release.

COMMERCIAL CATCH ASSESSMENT

The sampling goal of examining 25% of the Central District driftnet harvest, and 15% of the coho salmon harvested from each Central District Upper Subdistrict setnet statistical area was met in 1996. However, the goal of examining 35% of the coho salmon harvested from each Northern District statistical area was not met for statistical areas 247-20, 247-30, and 247-70. It was not always possible to examine pure loads from 247-20, 247-30, and 247-70 statistical areas as tender operators would often mix coho salmon from these areas with coho salmon harvested from other statistical areas prior to reaching port.

The sampling effort of the commercial harvest provided relatively precise estimates. Relative precision of the total harvest of hatchery-produced fish by the UCI commercial fisheries was 5%. Estimates were most precise for the Northern District setnet fisheries (5%) and the Central District driftnet (6%), and much less precise for the Central District eastside setnet fishery (29%). The estimated harvest by the eastside setnet fishery was not as precise because a lower proportion of the harvest was sampled and because fewer tags were recovered from this fishery.

Harvest estimates of coho salmon stocked into Bird, Campbell, and Ship creeks had good precision (relative precision < 10%) because: (1) approximately 30% of the smolt in each release group were tagged, and (2) a large sample from the commercial harvest was obtained. Estimates of harvest of fish stocked into Little Susitna River were also relatively precise (10.5%). Harvest estimate of coho salmon stocked into Fish Creek was less precise (59%) than other stocked cohorts because very few of these tagged fish were observed in the sampled commercial harvests. Fish Creek was last stocked in 1993 and the majority of coho salmon returning from this stocking were harvested in 1994 and 1995.

The pattern of commercial coho salmon harvest was typical of previous years. Since 1993, the Central District driftnet fishery has harvested 45% or greater of the total coho salmon harvested in the sampled UCI fisheries, the Central District eastside setnet fishery has harvested at least 12%, and the Northern District setnet fishery has harvested at least 24%. Of the total coho salmon harvested in the sampled UCI fisheries in 1996, 59% were taken in the Central District driftnet fishery, 14% were harvested in the Central District eastside setnet fishery, and 27% were harvested in the Northern District setnet fishery. The majority of hatchery-stocked fish harvested

in sampled UCI commercial fisheries was taken in the Central District driftnet fishery: 59% of the total commercial harvest of coho salmon stocked into Anchorage urban systems (Bird, Campbell, and Ship creeks combined) and 65.5% of the total commercial harvest of coho salmon stocked into Little Susitna River. The Northern District setnet fishery took 35% of the estimated total commercial harvest of coho salmon stocked into Anchorage urban systems and 23% of the estimated total commercial harvest of coho salmon stocked into Little Susitna River. The Central District eastside setnet fishery took only 6% of the total commercial harvest of coho salmon stocked into the Anchorage urban systems and 11.5% of the coho salmon stocked into Little Susitna River, with most of the harvest occurring in statistical areas 244-30 and 244-40 which are nearest the Northern District.

Estimates of harvest of all marked cohorts observed within the statistical area/day strata are not independent. In previous years (Hoffmann and Hasbrouck 1994, Stratton et al. 1996), incorporation of covariance terms resulted in insignificant differences in total variance estimates (Bernard and Clark 1996). This was also true for the 1996 data. As such, covariance terms were not used in 1996 calculations, and therefore estimates of total variance are biased somewhat high.

Our results justify continuation of the stocking program. Additional streams flowing into Knik and Turnagain arms may be stocked depending on availability of brood stock. The terminal and commercial assessment programs should continue to evaluate the stocking program and to measure the success of the stocking program. The commercial assessment program will be necessary for assessment of any future coded wire tagging of wild stock coho salmon from the Susitna River drainage.

Recommendations for the future include modified sampling of several statistical areas in the Northern District (i.e., 247-10, 247-20, 247-30, 247-50, 247-70, 247-80, and 247-90) to obtain samples specific to each statistical area. This could be accomplished by placing technicians on-board tenders, closely following buying patterns of processors inseason, and obtaining assistance from tender boat operators and processors in keeping harvested coho salmon separated by statistical area. These steps would improve our ability to sample pure loads of coho salmon harvested in these statistical areas.

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LITERATURE CITED

ADF&G (Alaska Department of Fish and Game). 1997. Run forecasts and harvest projections for 1997 Alaska salmon fisheries and review of the 1996 season. In H. J. Geiger, B. Frenette, and D. Hart, editors. Commercial Fisheries Management and Development Division, Regional Information Report No. 5J97-10, Juneau.

Bartlett, L. D. 1996a. Escapement, and stock statistics for coho salmon on the Little Susitna River and selected Matanuska-Susitna Valley, Alaska streams during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-16, Anchorage.

Bartlett, L. D. 1996b. Escapement, and stock statistics for coho salmon of the Little Susitna River and selected streams of the Matanuska-Susitna Valley, Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-39, Anchorage.

Bernard, D. R. and J. E. Clark. 1996. Estimating salmon harvest based on return of coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences 53:2323-2332.

Blankenship, H. L. 1990. Effects of time and fish size on coded wire tag loss from chinook and coho salmon. Pages 237-243 in N. C. Parker, A. E. Giorgi, R. C. Heidinger, D. B. Jester, Jr., E. D. Prince, and G. A. Winans, editors. Fish-marking techniques. American Fisheries Society Symposium 7.

Carlon, J. and J. J. Hasbrouck. 1993. Marking juvenile coho salmon in the Kenai River with coded, microwire tags. Alaska Department of Fish and Game, Fishery Data Series No. 93-52, Anchorage.

Carlon, J. and J. J. Hasbrouck. 1996. Estimated harvest of coho salmon of Kenai River origin in commercial fisheries of Upper Cook Inlet Alaska, 1993-1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-7, Anchorage.

Carlon, J. and J. J. Hasbrouck. 1997. Assessment of coho salmon from the Kenai River, Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 97-7, Anchorage.

Carlon, J. and J. J. Hasbrouck. *In prep.* Assessment of coho salmon from the Kenai River, Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series report, Anchorage.

Cyr, P., B. Stratton, J. J. Hasbrouck, D. Waltemyer, and K. Rudge. *Unpublished*. Northern Cook Inlet urban area coho salmon program: terminal assessment and commercial catch sampling elements. Operational Plan FY97. Located at: Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.

Cyr, P., B. Stratton, and J. J. Hasbrouck. 1997. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1995. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series No. 97-3, Anchorage.

Hoffmann, A. G. and J. J. Hasbrouck. 1994. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-45, Anchorage.

Howe, A. L., G. Fidler, A. E. Bingham, and M. J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage.

Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.

Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. 1997. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29, Anchorage.

Meyer, S., D. Vincent-Lang, and D. McBride. *Unpublished*. Goal statement and study plan for the development of a stock assessment program for Upper Cook Inlet coho salmon stocks (1991). Located at: Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.

Mills, M. J. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (SW-1), Juneau.

LITERATURE CITED (Continued)

Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-1), Juneau.

Mills, M. J. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau.

Mills, M. J. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau.

Mills, M. J. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-I-A), Juneau.

Mills, M. J. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-I-A), Juneau.

Mills, M. J. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-I-A), Juneau.

Mills, M. J. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-I-A), Juneau.

Mills, M. J. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (RT-2), Juneau.

Mills, M. J. 1987. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau.

Mills, M. J. 1988. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.

Mills, M. J. 1989. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau.

Mills, M. J. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.

Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.

Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.

Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.

Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage.

Peltz, L. R. and P. A. Hansen. 1994. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-21, Anchorage.

Peltz, L. R. and D. Starkey. 1993. Summary and synthesis of production, marking, and release data for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska, in 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-51, Anchorage.

Sandercock, F. K. 1991. Life history of coho salmon (Oncorhynchus kisutch). In C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press. Vancouver, B. C., Canada.

LITERATURE CITED (Continued)

Starkey, D., C. Olito, and P. Hansen. 1996. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-15, Anchorage.

Starkey, D., C. Olito, and P. Hansen. 1997. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-13, Anchorage.

Starkey, D., L. Peltz, and P. Hansen. 1995. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-13, Anchorage.

Stratton, B., J. J. Hasbrouck, and P. Cyr. 1996. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1994. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series No. 96-4, Anchorage.

Whitmore, C. and D. Sweet. 1997. Area management report for the recreational fisheries of Northern Cook Inlet, 1996. Alaska Department of Fish and Game, Fishery Management Report No. 97-3, Anchorage.

APPENDIX A. COHO SALMON ESCAPEMENT COUNTS AT SHIP, BIRD, AND CAMPBELL CREEKS AND SELECTED TURNAGAIN ARM STREAMS

Appendix A1.-Coho salmon weir counts and number of coho salmon sampled for missing adipose fins in Ship Creek, 1996.

	Adipose Fin		Total	Head Collection		Coho Escapement	
Date	Present	Absent	Coho	Daily	Total	Daily	Total
7/17	3	1	4	0	0	4	4
7/18	1	0	1	0	0	1	5
7/19	3	0	3	0	0	3	8
7/20 **					0	0	8
7/21	7	1	8	1	1	7	15
7/22	13	7	20	2	3	18	33
7/23 [a]	25	6	31	2	5	29	62
7/24	0	1	1	0	5	1	63
7/25	0	2	2	0	5	2	65
7/26	3	3	6	1	6	5	70
7/27 *					6		70
7/28 *					6		70
7/29	28	7	35	1	7	34	104
7/30	39	11	50	3	10	47	151
7/31	69	28	97	9	19	88	239
8/1 *					19	0	239
8/2 *					19	0	239
8/3 *					19	0	239
8/4 *					19	0	239
8/5	65	20	85	10	29	75	314
8/6	60	18	78	9	38	69	383
8/7 [b]	27	23	50	11	49	27	410
8/8	17	5	22	2	51	20	430
8/9 [c]	0	4	4	4	55	0	430
8/10	47	20	67	20	75	47	477
8/11	117	44	161	44	119	117	594
8/12	35	6	41	4	123	37	631
8/13	34	10	44	5	128	39	670
8/14	52	16	68	8	136	60	730
8/15	21	14	35	14	150	21	751
8/16	26	10	36	3	153	33	784
8/17 *					153	0	784
8/18 *					153	0	784
8/19	23	3	26	1	154	25	809
8/20	11	4	15	4	158	11	820
8/21	10	4	14	4	162	10	830
8/22	14	8	22	8	170	14	844
8/23	12	0	12	0	170	12	856
Subtotal	762	276	1,038		170		856

-continued-

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Date	Adipose Fin		Total	Head Collection		Coho Escapement	
	Present	Absent	Coho	Daily	Total	Daily	Total
8/24	2	0	2	0	170	2	858
8/25	10	4	14	2	172	12	870
8/26	6	4	10	1	173	9	879
8/27	11	3	14	3	176	11	890
8/28	12	2	14	0	176	14	904
8/29	4	3	7	1	177	6	910
8/30	15	2	17	0	177	17	927
8/31 *					177	0	927
9/1 *					177	0	927
9/2 *					177	0	927
9/3 *					177	0	927
9/4	11	3	14	0	177	14	941
9/5	6	2	8	1	178	7	948
9/6 *					178	0	948
9/7 *					178	0	948
9/8 *					178	0	948
9/9 *					178	0	948
9/10 *					178	0	948
9/11 *					178	0	948
9/12	9	0	9	0	178	9	957
9/13	2	0	2	0	178	2	959
9/14 *					178	0	959
9/15 *					178	0	959
9/16 *					178	0	959
9/17	12	1	13	0	178	13	972
9/18	15	1	16	0	178	16	988
9/19 **					178	0	988
9/20 [d]	13	0	13	0	178	13	1,001
Total	890	301	1,191		178		1,001

* Weir closed - not checked.

** Weir open - not checked.

[a] One weir mortality (male - not included in escapement).

[b] Twelve adipose clipped coho taken for "Becoming an Outdoors Woman Workshop" (heads not taken).

[c] Weir open for only 6 hours prior to checking.

[d] Last day weir in operation.

Appendix A2.-Coho salmon escapement index counts from foot surveys in Bird and Campbell creeks, 1996.

Stream	Date	Live	Dead	Total
Bird Creek Drainage				
Penguin Creek	19-Sep	147	0	147
Bird Creek Falls downstream to marker cable	19-Sep	22	0	22
Total		169	0	169
Campbell Creek Drainage				
Upper S. Fork	30-Sep	39	0	39
Lower S. Fork	30-Sep	1,353	0	1,353
Upper N. Fork	30-Sep	29	0	29
Lower N. Fork	30-Sep	191	0	191
Total		1,612	0	1,612

Appendix A3.-Coho salmon escapement index peak counts from aerial surveys in selected Turnagain Arm streams, 1994-1996.

Stream	1994	1995	1996
Twentymile River Drainage			
Ahjo Creek	75	65	0
NE Fork	75	210	275
Mainstem	780	560	940
Beaver Pond	NC[a]	120	30
Glacier River	50	0	NC[a]
Upper Carmen River	0	0	0
South Fork Carmen River	6	0	0
Total	986	955	1,245
Portage Creek Drainage			
Mainstem[b]	40	10	NC[a]
Upper Railroad Slough	0	210	120
Lower Railroad Slough	0	40	60
Williwaw[b]	30	35	2
Placer Creek	0	57	10
Total	70	352	192
Placer River Drainage			
Sloughs and Mainstem	55	90	45
Skookum Creek	750	720	410
Explorer Creek[a]	804	350	75
Total	1,609	1,160	530

[a] No count.

[b] Foot survey counts conducted by United States Forest Service personnel.

APPENDIX B. ESTIMATES BY RELEASE SITE OF COHO SALMON STOCKED IN 1993, 1994, AND 1995 THAT WERE HARVESTED IN SAMPLED UPPER COOK INLET COMMERCIAL FISHERIES IN 1996

Appendix B1.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District driftnet (244-00, 245-00) commercial harvest, 1996.

Date	Coho Catch	Fish Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/02	1,480	0		0		0.0%	0.0%
7/5	6,420	0		0		0.0%	0.0%
7/8	10,806	0		0		0.0%	0.0%
7/09-7/12	5,279	0		0		0.0%	0.0%
7/15	54,057	0		0		0.0%	0.0%
7/16	901	0		0		0.0%	0.0%
7/17	3,978	0		0		0.0%	0.0%
7/19	46,531	0		0		0.0%	0.0%
7/20-7/21	2,925	0		0		0.0%	0.0%
7/22	14,153	0		0		0.0%	0.0%
7/25	2,694	0		0		0.0%	0.0%
7/26	4,541	0		0		0.0%	0.0%
7/27	1,491	0		0		0.0%	0.0%
7/28	1,120	0		0		0.0%	0.0%
7/29	8,208	0		0		0.0%	0.0%
8/2	1,113	22	21	22	21	1.9%	1.9%
8/5	4,484	0		0		0.0%	0.0%
8/9	1,180	0		0		0.0%	0.0%
Total[a]	171,361	22	21	22	21	0.0%	0.0%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B2.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District driftnet (244-00, 245-00) commercial harvest, 1996.

Date	Coho Catch	Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/02	1,480	0		0		0.0%	0.0%
7/5	6,420	0		0		0.0%	0.0%
7/8	10,806	6	6	6	6	0.1%	0.1%
7/09-7/12	5,279	0		0		0.0%	0.0%
7/15	54,057	0		0		0.0%	0.0%
7/16	901	0		0		0.0%	0.0%
7/17	3,978	0		0		0.0%	0.0%
7/19	46,531	0		0		0.0%	0.0%
7/20-7/21	2,925	0		0		0.0%	0.0%
7/22	14,153	0		0		0.0%	0.0%
7/25	2,694	0		0		0.0%	0.0%
7/26	4,541	0		0		0.0%	0.0%
7/27	1,491	0		0		0.0%	0.0%
7/28	1,120	0		0		0.0%	0.0%
7/29	8,208	0		0		0.0%	0.0%
8/2	1,113	0		0		0.0%	0.0%
8/5	4,484	0		0		0.0%	0.0%
8/9	1,180	0		0		0.0%	0.0%
Total[a]	171,361	6	6	6	6	0.0%	0.0%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B3.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1996.

Date	Coho Catch	Ship Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/19	2,550	0		0		0.0%	0.0%
7/26	588	0		0		0.0%	0.0%
7/29	962	0		0		0.0%	0.0%
8/2	523	0		0		0.0%	0.0%
8/5	1,428	0		0		0.0%	0.0%
8/9	2,184	0		0		0.0%	0.0%
8/12	2,027	4	4	4	4	0.2%	0.2%
8/16	1,823	0		0		0.0%	0.0%
8/19	1,595	0		0		0.0%	0.0%
8/23	677	0		0		0.0%	0.0%
8/26	1,722	0		0		0.0%	0.0%
8/30-9/02	270	0		0		0.0%	0.0%
9/6	95	0		0		0.0%	0.0%
Total[a]	16,444	4	4	4	4	0.0%	0.0%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B4.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Central District driftnet (244-00, 245-00) commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/02	1,480	0		0		0		0		0		0.0%	0.0%
7/5	6,420	16	15	85	37	33	23	113	42	247	62	3.9%	1.0%
7/8	10,806	76	27	92	31	102	32	176	42	445	67	4.1%	0.6%
7/09-7/12	5,279	46	22	49	24	97	33	70	28	263	54	5.0%	1.0%
7/15	54,057	679	110	1,119	146	825	124	917	129	3,540	256	6.5%	0.5%
7/16	901	21	21	0		22	21	43	29	85	42	9.5%	4.6%
7/17	3,978	49	34	26	25	76	43	123	54	274	81	6.9%	2.0%
7/19	46,531	1,121	116	1,118	120	963	110	990	110	4,192	228	9.0%	0.5%
7/20-7/21	2,925	117	46	41	28	122	48	59	33	339	80	11.6%	2.7%
7/22	14,153	419	60	443	63	495	66	443	62	1,800	126	12.7%	0.9%
7/25	2,694	144	44	61	29	120	41	218	54	542	86	20.1%	3.2%
7/26	4,541	160	31	133	29	152	31	155	31	599	61	13.2%	1.3%
7/27	1,491	16	15	33	23	114	42	64	31	227	59	15.2%	3.9%
7/28	1,120	38	18	30	17	30	16	19	13	118	32	10.5%	2.9%
7/29	8,208	223	44	319	54	364	58	324	54	1,230	105	15.0%	1.3%
8/2	1,113	92	65	0		48	48	93	65	234	103	21.0%	9.3%
8/5	4,484	143	63	152	67	149	66	29	28	473	116	10.5%	2.6%
8/9	1,180	0		0		0		0		0		0.0%	0.0%
Total[a]	171,361	3,360	219	3,702	232	3,711	232	3,837	234	14,609	458	8.5%	0.3%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B5.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Central District Ninilchik Beach (244-21) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Campbell Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/12	490	0		0		0		0.0%	0.0%
7/14-7/15	238	0		0		0		0.0%	0.0%
7/16	110	8	7	0		8	7	7.0%	6.5%
7/17	168	0		0		0		0.0%	0.0%
7/19	210	0		0		0		0.0%	0.0%
7/20-7/22	626	75	75	0		75	75	12.0%	11.9%
7/25	474	0		0		0		0.0%	0.0%
7/26	1,454	0		31	31	31	31	2.1%	2.1%
7/27-7/28	1,575	0		0		0		0.0%	0.0%
7/29	1,054	11	11	23	16	34	19	3.2%	1.8%
8/2	562	0		0		0		0.0%	0.0%
8/5	674	0		0		0		0.0%	0.0%
8/9	474	0		0		0		0.0%	0.0%
8/12	295	0		0		0		0.0%	0.0%
Total[a]	8,404	94	76	54	34	148	83	1.8%	1.0%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B6.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Central District Cohoe Beach (244-22) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/12	605	18	18	0		0		18	18	37	25	6.0%	4.1%
7/14-7/15	426	0		0		0		28	27	28	27	6.5%	6.4%
7/16	135	0		0		0		0		0		0.0%	0.0%
7/17	181	0		0		0		0		0		0.0%	0.0%
7/19	322	7	7	8	7	0		8	7	23	12	7.1%	3.8%
7/20-7/22	504	25	25	27	26	26	26	51	35	130	57	25.7%	11.3%
7/25	403	10	10	0		0		0		10	10	2.5%	2.4%
7/26	739	0		0		0		0		0		0.0%	0.0%
7/27-7/28	1,659	0		0		0		0		0		0.0%	0.0%
7/29	532	0		0		9	8	9	8	17	12	3.3%	2.2%
8/2	397	0		0		0		0		0		0.0%	0.0%
8/5	969	0		0		0		32	32	32	32	3.3%	3.3%
8/9	609	0		0		0		0		0		0.0%	0.0%
8/12	163	0		0		0		0		0		0.0%	0.0%
Total[a]	7,644	61	33	35	27	35	27	146	59	276	77	3.6%	1.0%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B7.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Central District Kalifonsky Beach (244-30) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/12	225	0		24	24	0		0		24	24	10.8%	10.6%
7/14-7/15	610	13	13	0		14	13	13	13	40	22	6.6%	3.7%
7/16-7/17	903	0		0		0		0		0		0.0%	0.0%
7/19	529	0		28	19	0		14	13	42	23	7.9%	4.4%
7/20-7/22	562	0		0		0		0		0		0.0%	0.0%
7/25	332	0		0		0		0		0		0.0%	0.0%
7/26	424	61	34	0		21	21	21	20	103	45	24.3%	10.6%
7/27-7/28	684	0		0		0		0		0		0.0%	0.0%
7/29	431	17	17	0		35	24	34	24	87	38	20.2%	8.8%
8/2	1,081	0		0		0		0		0		0.0%	0.0%
8/5	1,016	0		0		0		0		0		0.0%	0.0%
8/9	565	0		0		0		0		0		0.0%	0.0%
8/12	233	0		0		0		11	10	11	10	4.6%	4.4%
Total[a]	7,595	91	40	53	31	70	35	93	37	307	72	4.0%	0.9%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B8.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Central District Salamatof Beach (244-40) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
7/01-7/12	552	0		0		0		0		0		0.0%	0.0%
7/15	942	0		0		0		0		0		0.0%	0.0%
7/16	569	0		8	8	8	8	8	7	24	13	4.3%	2.3%
7/19	1,186	34	23	54	30	53	30	51	29	191	56	16.1%	4.7%
7/20-7/22	1,877	103	72	55	54	0		0		158	90	8.4%	4.8%
7/25	1,989	66	46	0		34	34	33	33	133	66	6.7%	3.3%
7/26-7/27	2,259	71	49	112	64	0		0		183	81	8.1%	3.6%
7/28	1,860	0		161	161	0		0		161	161	8.7%	8.7%
7/29	1,162	70	40	0		49	34	0		119	52	10.2%	4.5%
8/2	866	0		0		11	10	0		11	10	1.3%	1.2%
8/5	1,746	0		0		22	15	0		22	15	1.3%	0.8%
8/9	981	0		7	6	7	6	0		14	9	1.4%	0.9%
8/12	916	0		0		0		11	7	11	7	1.2%	0.8%
Total[a]	16,905	344	109	397	184	184	60	103	45	1,028	227	6.1%	1.3%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B9.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Northern District westside (247-10, 247-20, 247-30) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/15	18,867	65	18	56	17	12	8	12	8	146	27	0.8%	0.1%
7/19	7,517	61	14	46	13	27	10	22	9	155	23	2.1%	0.3%
7/26	7,125	199	41	70	25	59	23	58	22	386	58	5.4%	0.8%
7/29	7,698	151	20	156	22	79	15	88	16	473	37	6.1%	0.5%
8/02-8/05	1,579	12	8	13	8	18	10	12	8	55	17	3.5%	1.1%
8/9	1,361	0		21	9	5	5	5	4	31	11	2.3%	0.8%
8/12-8/23	866	0		0		0		0		0		0.0%	0.0%
Total[a]	45,013	488	52	362	41	201	32	196	31	1,247	80	2.8%	0.2%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B10.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/15	1,334	97	17	47	12	30	10	37	11	211	26	15.8%	1.9%
7/19	1,406	104	24	83	22	109	25	79	21	375	46	26.7%	3.3%
7/26	1,407	87	17	282	32	204	27	110	19	683	49	48.5%	3.5%
7/29	1,454	100	20	269	34	187	28	86	19	642	52	44.1%	3.6%
8/5	283	0		38	18	0		18	12	56	22	20.0%	7.7%
8/9	365	23	7	80	14	41	10	11	5	155	20	42.4%	5.4%
8/12-8/26	214	3	3	24	8	18	7	6	4	50	11	23.6%	5.3%
Total[a]	6,463	415	40	823	58	587	49	347	38	2,172	94	33.6%	1.5%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B11.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Northern District Fire Island (247-43) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
7/05-7/15	1,298	40	10	85	16	141	20	104	17	370	32	28.5%	2.5%
7/19	1,019	33	9	103	16	149	19	111	16	396	31	38.8%	3.1%
7/26	1,405	30	12	320	42	258	37	226	34	835	66	59.4%	4.7%
7/29	2,641	69	15	444	38	682	47	309	31	1,504	70	57.0%	2.6%
8/2	459	14	7	57	15	80	17	37	11	187	26	40.8%	5.7%
8/5	280	16	6	45	11	54	12	19	7	134	18	47.9%	6.6%
8/9	679	8	5	129	20	67	14	65	14	269	28	39.6%	4.2%
8/12	455	0		26	14	17	11	0		42	18	9.3%	3.9%
8/16	106	0		7	4	27	8	3	3	37	10	35.0%	9.1%
8/19	33	0		6	4	3	3	0		8	5	25.3%	13.9%
Total[a]	8,375	211	26	1,221	68	1,477	72	874	55	3,783	116	45.2%	1.4%

[a] Totals may not equal sum of individual estimates due to rounding.

Appendix B12.-Estimates ($\hat{r}_{ij}$) and standard errors (SE) of coho salmon stocked in 1995 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1996.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution			
		$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	$\hat{r}_{ij}$	SE	%	SE
6/28-7/19	2,550	0		0		0		0		0		0.0%	0.0%
7/26	588	49	49	52	52	0		50	49	152	87	25.8%	14.8%
7/29	962	0		24	16	35	19	34	19	92	31	9.6%	3.2%
8/2	523	0		0		15	15	0		15	15	2.9%	2.8%
8/5	1,428	0		25	14	25	14	16	11	67	22	4.7%	1.6%
8/9	2,184	0		0		11	11	22	15	34	18	1.5%	0.8%
8/12	2,027	8	8	60	21	42	18	41	17	152	34	7.5%	1.7%
8/16	1,823	5	4	5	5	5	5	10	6	26	10	1.4%	0.6%
8/19	1,595	0		5	4	5	4	5	4	15	7	0.9%	0.5%
8/23	677	0		0		0		0		0		0.0%	0.0%
8/26	1,722	6	5	0		0		0		6	5	0.3%	0.3%
8/30-9/02	270	0		0		0		0		0		0.0%	0.0%
9/6	95	0		0		0		0		0		0.0%	0.0%
Total[a]	16,444	68	50	172	60	139	35	178	59	558	104	3.4%	0.6%

[a] Totals may not equal sum of individual estimates due to rounding.